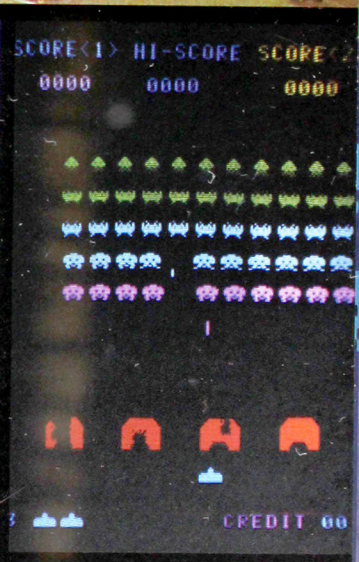
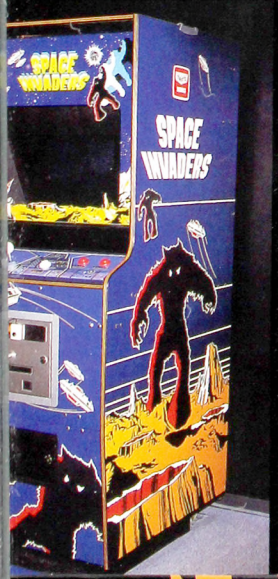
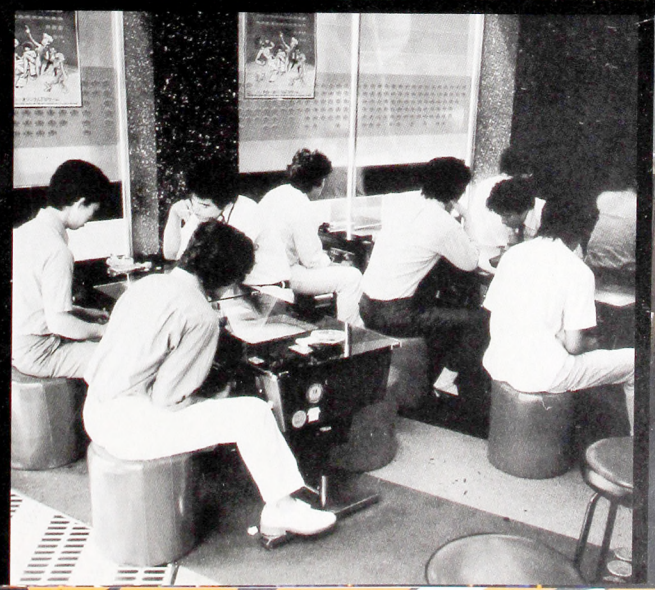
1 THE AGE OF SPACE INVADERS







· SPACE INVADERS MATERIALS COLLECTION

PLAY>>

CHAPTER 1 THE AGE OF SPACE INVADERS
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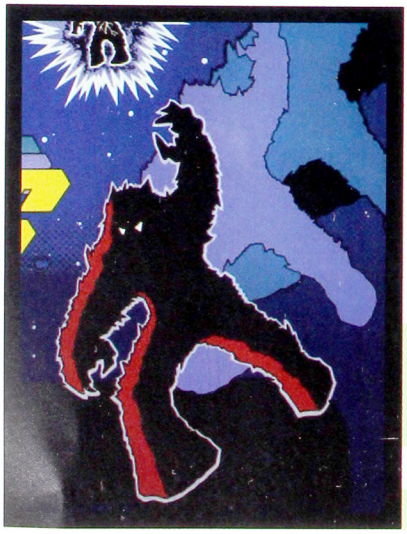
SPACE INVADERS GALLERY

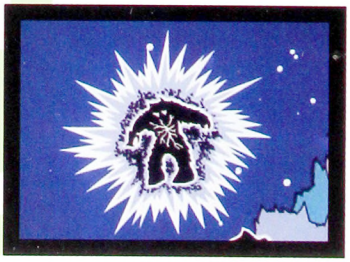
Space Invaders Gallery

Over forty years ago, Space Invaders appeared as though from, well – space. Let's take a look at some precious vintage documents and imagery.

01 >> SPACE INVADERS 1978.07

⬅⬆⬊ Space Invaders was produced in both cocktail and upright cabinets. The first thousand uprights utilized buttons instead of a joystick for movement. The photo is of a later cabinet.





TAITO
TAITRONICS

〈カラーＴＶ使用〉

T.T. SPACE INVADERS

ティーティー・スペースインベーダー

特許・意匠登録申請中

遊び方

- ●１人又は２人で遊びます。
- ●100円硬貨を投入し、１人用の場合は上側の２人用の場合は下側の、それぞれの白いボタンを押しゲーム開始です。
- ●ビーム砲ボタン(赤)で宇宙から進撃して来るインベーダーを撃破してください。又インベーダーからの攻撃を、コントロールボタンで左右に移動させながら、攻撃をかわしてください。
- ●インベーダーに基地を占領された時、ビーム砲を全部破壊された時はゲーム終了です。
- ●２人用の場合は、インベーダーにビーム砲が破壊されたら交代し、交互にゲームしてください。
- ●1500点(1000、1500点切換え可能)以上得点すると、ビーム砲の数が１門増えます。
- ●UFOを攻撃すると、ミステリーポイントとして得点が加算されます。

特　徴

- ★リアルな音で迫って来るインベーダーをビーム砲で撃破するゲーム内容は、爽快な気分を味わえます。
- ★時より、ＵＦＯが現われスリルがあります。攻撃し命中すると得点が加算されます。
- ★故障の少ない、耐久性に富んだマイクロプロセッサー及びI.C.を使用。
- ★シンプルな外装デザインは店内の雰囲気をこわさず、従来のテーブルとしても使用できます。
- ★ディップスイッチの切換えにより砲門の数を変えることができます。

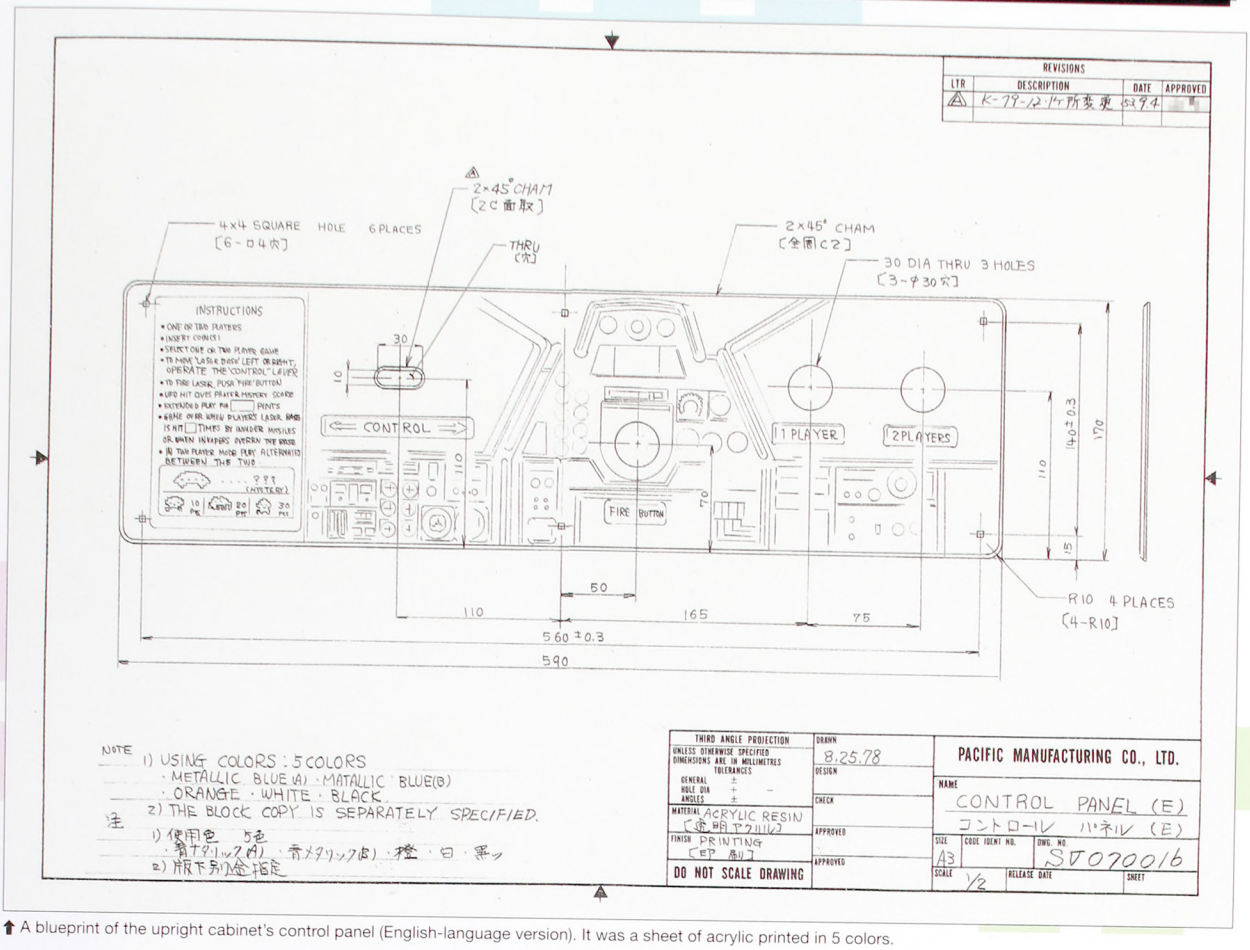
仕様

寸法…高さ600㎜～700㎜(アジャスタブル可)
横巾860㎜　奥行560㎜　重量52kg
消費電力105W　電圧ＡＣ100Ｖ　50/60Hz
１コイン　１プレイ
２コイン　２プレイ(又は２プレイヤー)

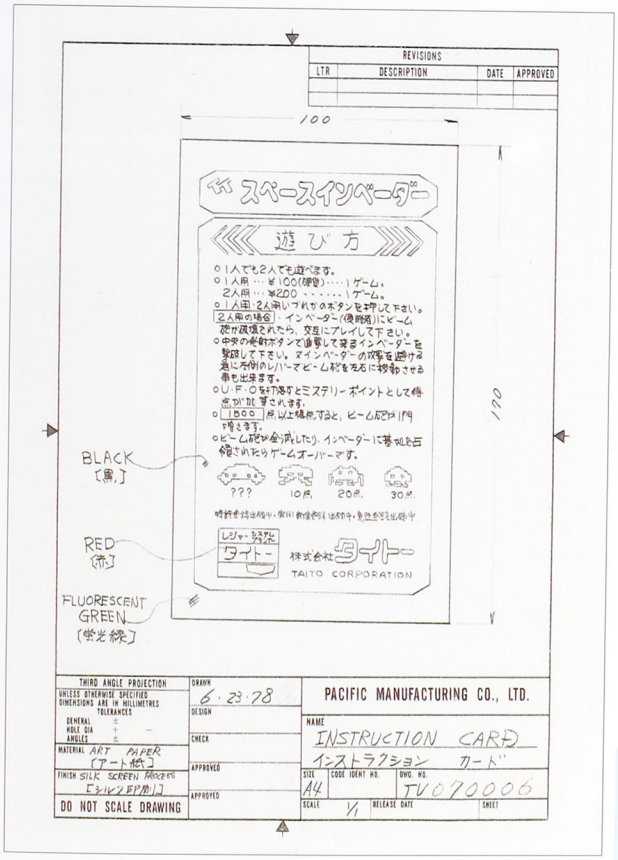
レジャーシステムプランナー
タイトー
TAITO

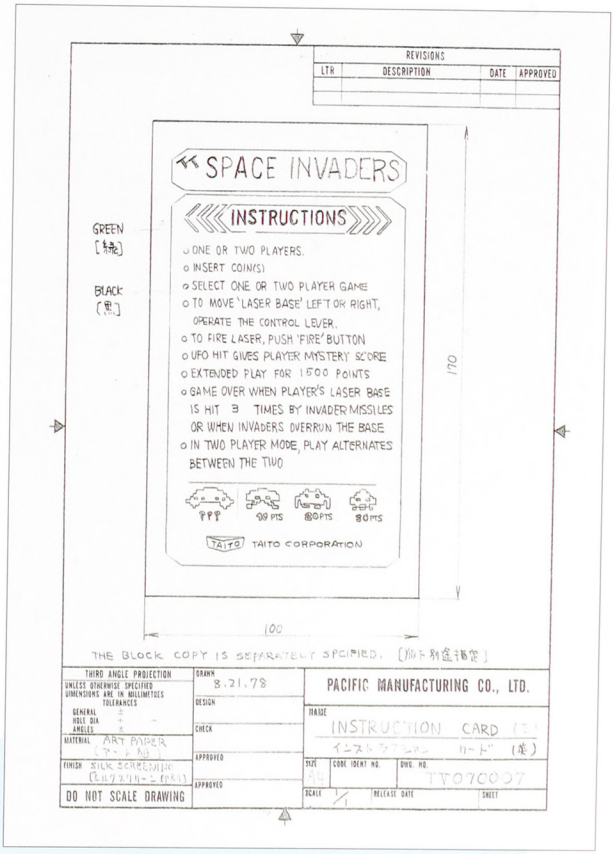
株式会社タイトー
本社 [redacted]
TAITO CORPORATION

SCORE
SPACE INVADERS
TAITO
TAITRONICS
SPACE INVADERS
SPACE INVADERS

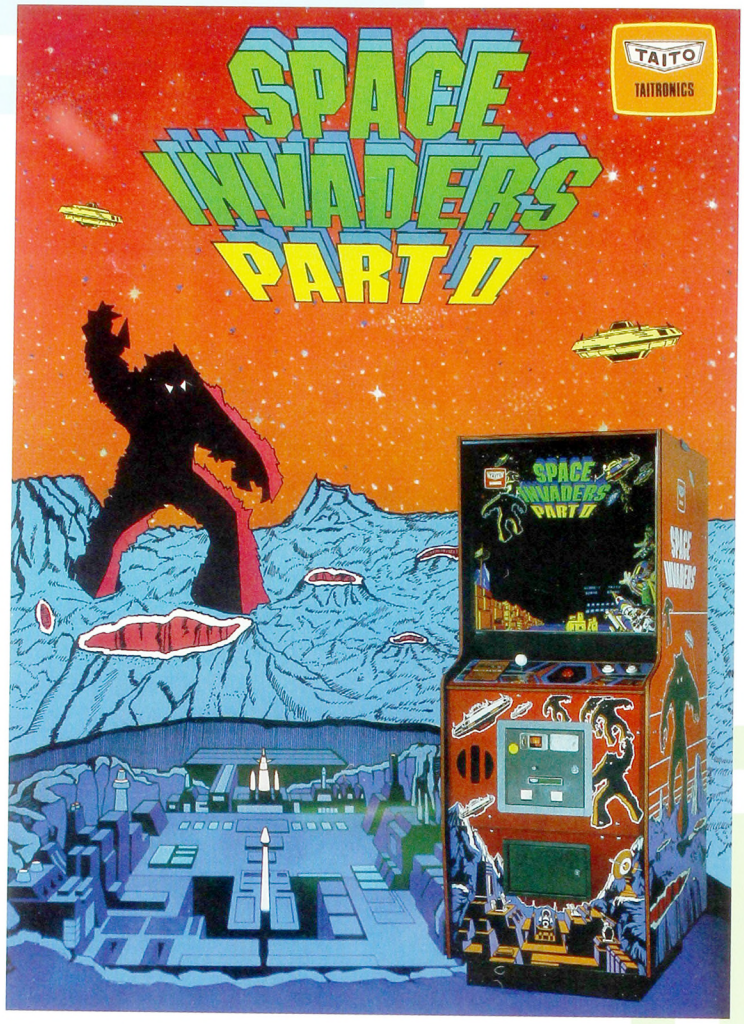


⬆ A blueprint of the upright cabinet's control panel (English-language version). It was a sheet of acrylic printed in 5 colors.



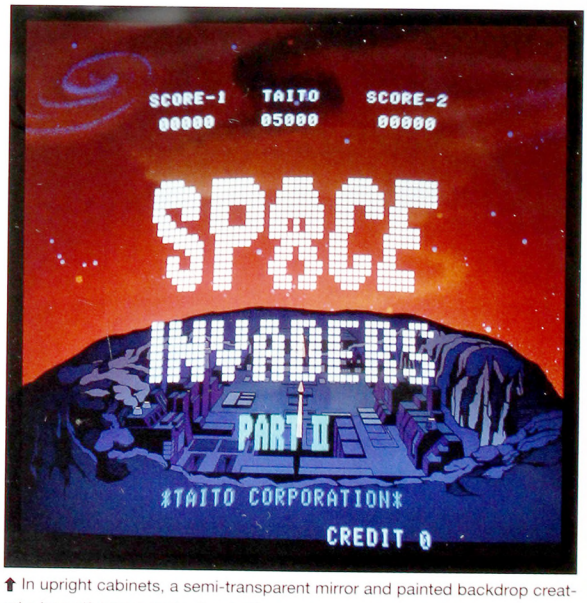

REVISIONS
LTR DESCRIPTION DATE APPROVED
SPACE INVADERS
INSTRUCTIONS
GREEN [緑]
BLACK [黒]
○ ONE OR TWO PLAYERS.
○ INSERT COIN(S)
○ SELECT ONE OR TWO PLAYER GAME
○ TO MOVE 'LASER BASE' LEFT OR RIGHT, OPERATE THE CONTROL LEVER.
○ TO FIRE LASER, PUSH 'FIRE' BUTTON
○ UFO HIT GIVES PLAYER 'MYSTERY' SCORE
○ EXTENDED PLAY FOR 1500 POINTS
○ GAME OVER WHEN PLAYER'S LASER BASE IS HIT 3 TIMES BY INVADER MISSILES OR WHEN INVADERS OVERRUN THE BASE
○ IN TWO PLAYER MODE, PLAY ALTERNATES BETWEEN THE TWO
??? 99 PTS 00 PTS 30 PTS
TAITO CORPORATION
170
100
THE BLOCK COPY IS SEPARATELY SPCIFIED. [版下別途指定]
THIRD ANGLE PROJECTION
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETRES
TOLERANCES
MATERIAL ART PAPER [アート紙]
FINISH SILK SCREENING [シルクスクリーン印刷]
DRAWN 8.21.78
DESIGN
CHECK
APPROVED
APPROVED
DO NOT SCALE DRAWING
PACIFIC MANUFACTURING CO., LTD.
NAME INSTRUCTION CARD (E) インストラクション カード (E)
SIZE A4
CODE IDENT NO.
DWG. NO. TT07C007
SCALE 1/1
RELEASE DATE
SHEET

⬆ Instruction card layout. Note the Japanese version is dated June 23, 1978.



⬇ "Part II" cabinets were bright red. The photo at upper right is of a conversion. "Part II" had both color and B&W versions.

⬅ "CL" refers to "color." The back of the pamphlet highlights the new octopus and UFO characters.

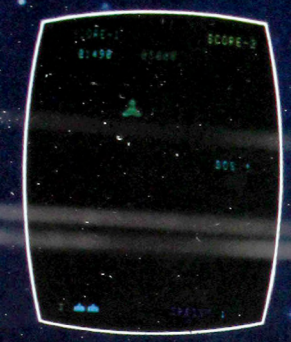


⬆ In upright cabinets, a semi-transparent mirror and painted backdrop created a beautiful composite visual effect.

TAITO
TAITRONICS

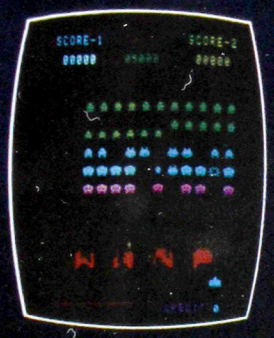
SPACE INVADERS PART II

スペースインベーダー・パートII・CL

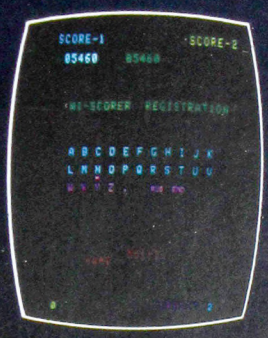


UFOに乗ったインベーダーがSOSを発し、援軍を呼ぶ。

レインボー打ちで、レインボーシャワーあらわる。

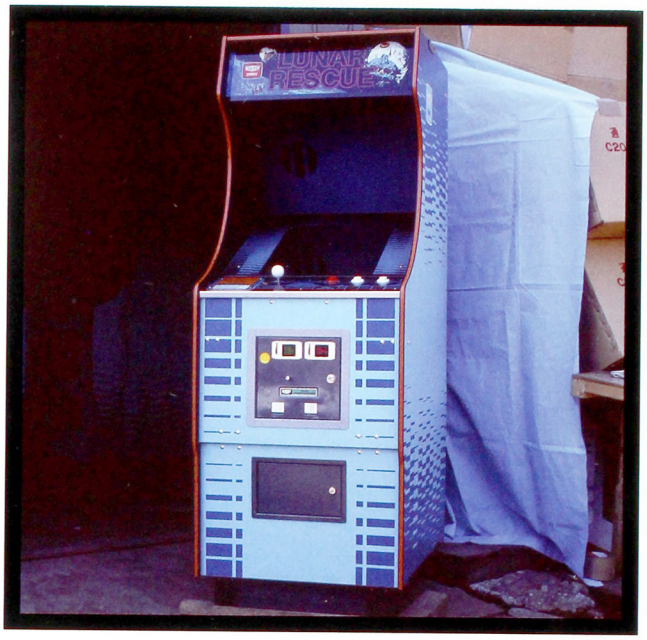


ナント！！
分身するインベーダー

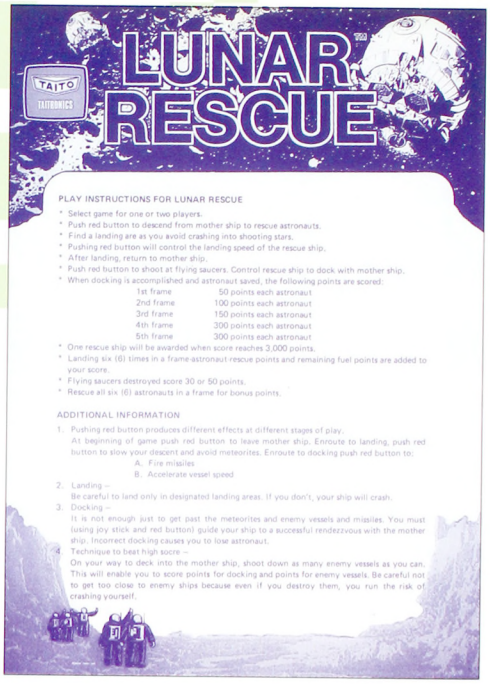


イニシャルが入れられます！
（最高得点）

03 >>> LUNA RESCUE 1979.11



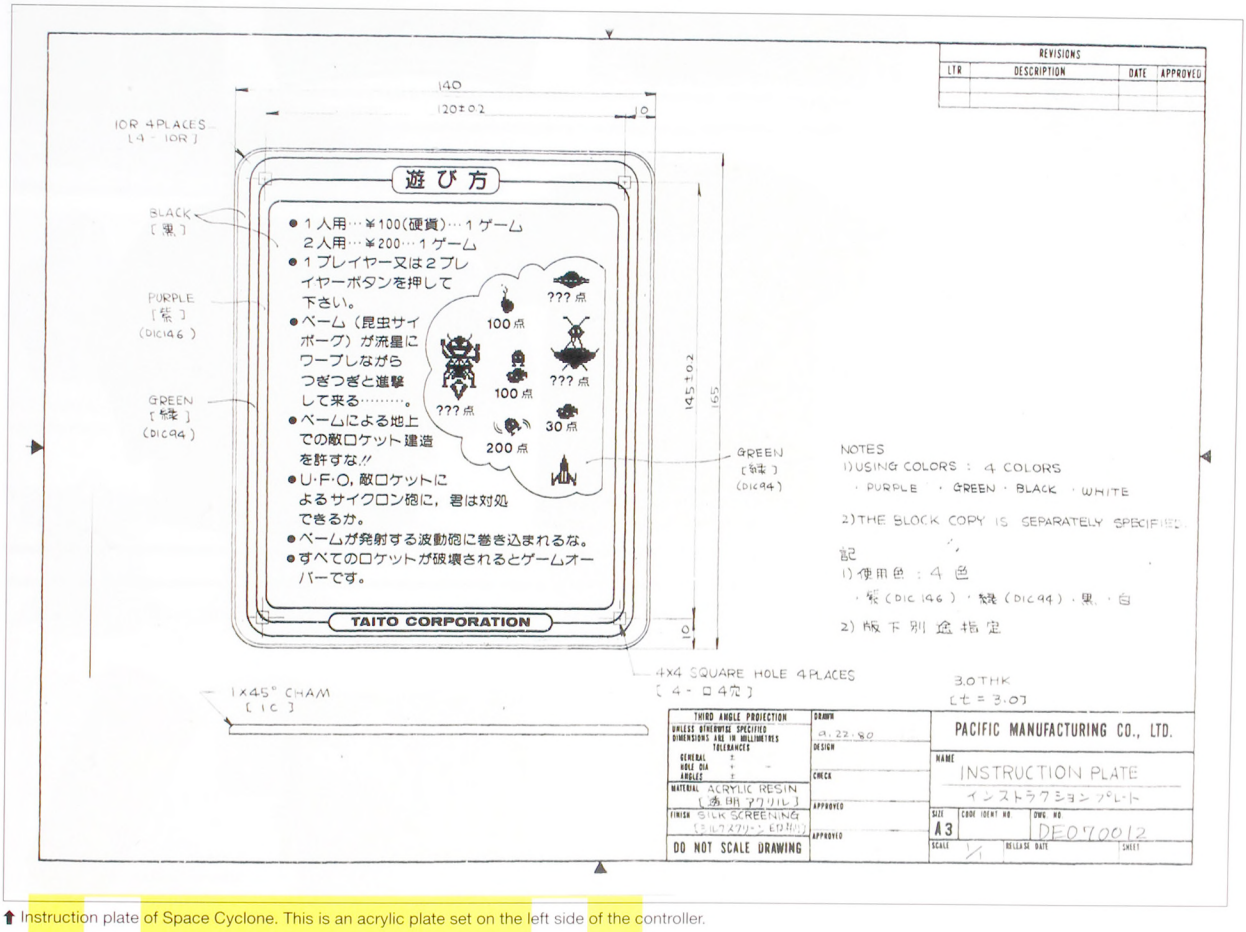
⬅⬉⬆ Lunar Rescue cocktail and upright cabinets. At upper left is a well-preserved front panel. In contrast to Space Invaders, the upright was decorated in a simple geometric pattern.


LUNAR
RESCUE
TAITO
TAITRONICS
PLAY INSTRUCTIONS FOR LUNAR RESCUE
* Select game for one or two players.
* Push red button to descend from mother ship to rescue astronauts.
* Find a landing are as you avoid crashing into shooting stars.
* Pushing red button will control the landing speed of the rescue ship.
* After landing, return to mother ship.
* Push red button to shoot at flying saucers. Control rescue ship to dock with mother ship.
* When docking is accomplished and astronaut saved, the following points are scored:
1st frame 50 points each astronaut
2nd frame 100 points each astronaut
3rd frame 150 points each astronaut
4th frame 300 points each astronaut
5th frame 300 points each astronaut
* One rescue ship will be awarded when score reaches 3,000 points.
* Landing six (6) times in a frame-astronaut-rescue points and remaining fuel points are added to your score.
* Flying saucers destroyed score 30 or 50 points.
* Rescue all six (6) astronauts in a frame for bonus points.
ADDITIONAL INFORMATION
1. Pushing red button produces different effects at different stages of play.
At beginning of game push red button to leave mother ship. Enroute to landing, push red button to slow your descent and avoid meteorites. Enroute to docking push red button to:
A. Fire missiles
B. Accelerate vessel speed
2. Landing –
Be careful to land only in designated landing areas. If you don't, your ship will crash.
3. Docking –
It is not enough just to get past the meteorites and enemy vessels and missiles. You must (using joy stick and red button) guide your ship to a successful rendezvous with the mother ship. Incorrect docking causes you to lose astronaut.
4. Technique to beat high socre –
On your way to deck into the mother ship, shoot down as many enemy vessels as you can. This will enable you to score points for docking and points for enemy vessels. Be careful not to get too close to enemy ships because even if you destroy them, you run the risk of crashing yourself.

⬅⬆ An English flyer for Lunar Rescue. The reverse is framed in a copy of the game's actual front panel. It seems cocktail editions were exported as well.

04 >>> SPACE CYCLONE 1980.10

← ↑ Space Cyclone cocktail and upright cabinets. Note the illustrated panel above the screen in the upright.



↑ Instruction plate of Space Cyclone. This is an acrylic plate set on the left side of the controller.

SPACE INVADERS GOODS COLLECTION

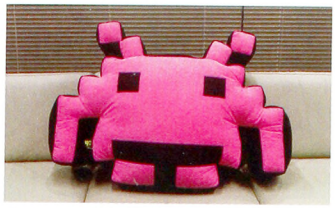
Space Invaders Merchandise

Over 40 years, Space Invaders has spawned a lot of merchandise. Here's a look at some of the more recent items.

40th Anniversary Items

Produced in 2018. The most eye-popping piece was a four million yen, solid gold Invader. Much of the following was produced in limited numbers, but maybe you can get lucky and still find some!

Gold Invader
Ginza Tanaka



Space Invaders
Jumbo Collection (Crab)

SPACE INVADERS Pinback Button

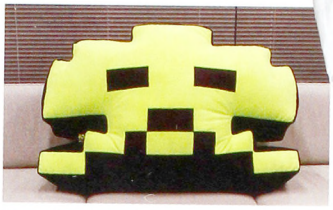
Taito Folding Fan
Space Invaders 40th

Space Invaders Silver Pendant
Ginza Tanaka

Space Invaders
Jumbo Collection (Squid)

SPACE INVADERS sukajan;
japanese souvenir jacket

Space Invaders
Denim Tote



Space Invaders
Jumbo Collection (Octopus)

INSTRUCTIONS
??? 30pts 20pts 10pts
INSERT COIN(S)
SELECT ONE OR TWO PLAYER GAME.
IF THE TWO PLAYER MODE, PLAY ALTERNATES BETWEEN THE TWO.
IF 1500 POINTS OR MORE ARE SCORED ONE EXTRA LASER BASE WILL BE ADDED.
WHEN THE LAST LASER BASE IS HIT OR THE BASE IS OVERRUN BY INVADERS, THE GAME ENDS.

SPACE INVADERS 40th
INSTRUCTIONS T-Shirt

SPACE INVADERS
40th Shell Parka

30th Anniversary Items

Commemorative prizes were produced to celebrate the 30th anniversary in 2008. So too was everything from fashion accessories to electric guitars.

Space Invaders Cookies

Lotte
Space Invaders Gum Green Gum
Space Invaders Gum Mint Blue

Nestle
Space Invaders
Kit Kat

Koike-ya
Space Invaders
Potato Chip
Tube can

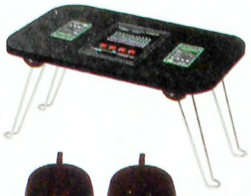
※NOTE: All are out of production.

PRIZE

Taito is known for its arcades, and Japanese arcades are famed for their crane games. Here's a sampling of co-branded products produced as prizes over the years. There are so many of them that completing a collection would be a huge challenge.

December 2018
Space Invaders & Maruchan
Red Kitsune Donburi Instant Noodles

November 2018
Consomme Punch Potato Chips &
Space Invaders 40th
Potato chip can



October 2018
Space Invaders
mini-table

October 2018
Space Invaders Light-up Mouse & Mousepad (2 types)

2003
Space Invaders Mah-Jongg

October 2008
Space Invaders
Headphones

Hatsune Miku / Taito Collaboration

Hatsune Miku
Taito Uniform
Art by Mago

Hatsune Miku
Taito Uniform 2
Art by Mago

Hatsune Miku / Space Invaders
Keychain
Art by Puchi-Devil

Hatsune Miku / Space Invaders
Coffee Mugs
Art by Puchi-Devil

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Touhou Project / Taito Collaboration

Touhou Project
Keychains

Touhou Project
Printed Totes

Touhou Project
Notebook-style Phone Case

Touhou Project
Blankets

※NOTE: All are out of production.

© Team Shanghai Alice

AND INVADERS

This apparel brand launched before the Tokyo Game Show 2018, based on the concept of Space Invaders "invading" people's closets and personal spaces.

AND INVADERS
Hoodies Parka

AND INVADERS
Hoodies Parka

AND INVADERS
Fanny pack

AND INVADERS
Record bag

AND INVADERS
Roll-up bag

AND INVADERS
Scissor bag

AND INVADERS Suitcase

AND INVADERS T-Shirts "Attack"

AND INVADERS T-Shirts "Random"

FREEing

From FREEing, a company with a reputation for producing high quality figures, comes the Monster depicted in the side art of the Space Invaders upright cabinet!

figma SPACE INVADERS MONSTER

HARDCC

Hardcore Chocolate, a t-shirt brand with a flare for collaborations with other industries, has taken on Space Invaders, too!

TAITO x HARDCORE CHOCOLATE SPACE INVADERS 1978 Purple

SPACE INVADERS APPAREL

MEGARAGE, a shop that handles not only Space Invaders but also many other Taito goods, offers a wide range of T-shirts, hoodies and caps.

Insert coin Hoodie

MEGARAGE NEVER OVER Denim tote bag

SPACE INVADERS Hoodie MEGARAGE Black

SPACE INVADERS Hoodie MEGARAGE Navy

SPACE INVADERS one point Polo shirt Black

SPACE INVADERS one point Polo shirt Navy

SPACE INVADERS Striped Hoodie Navy

SPACE INVADERS Striped Hoodie White

SPACE INVADERS Flat visor mesh cap Black

SPACE INVADERS Flat visor mesh cap Heather gray/Black

SPACE INVADERS SUPREME LEADER Jacket Black

SPACE INVADERS SUPREME LEADER Jacket Olive Drab

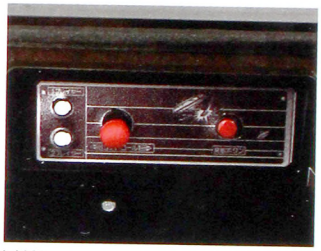
MEGARAGE NEVER OVER T-shirt

SPACE INVADERS 1978 T-Shirt

SPACE INVADERS
King of Arcade
Games T-shirt Black

HELMETS.

Helmets does a lot of retro gaming-related merchandise.



1/12 SPACE INVADERS Cabinet plastic model kit

VIDEO GAME TOKYO (Lam Co., Ltd.)

What a lineup of curtains from VIDEO GAME TOKYO, a brand that redesigns game titles from a wide range of ages and genres!

VIDEO GAME TOKYO SPACE INVADERS UFO Series Foil Stamping T-shirt

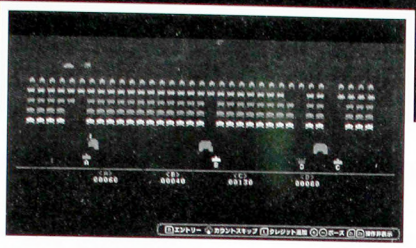
VIDEO GAME TOKYO SPACE INVADERS UFO Series Foil Stamping Parka Black

VIDEO GAME TOKYO SPACE INVADERS Curtain with blackout

A guide to helping you get the most out of the games included. There's more than forty years worth of titles here!

SPACE INVADERS GIGAMAX 4SE

Space Invaders Gigamax 4SE



GAME DATA

Released	Hardware	Controls
2018	Custom	1 stick + 1 button

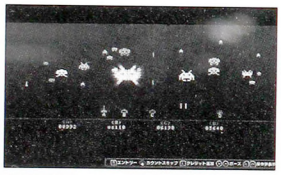
Invaders go Widescreen! 4 Players Simultaneous!

Created for the Space Invaders 40th Anniversary celebration in 2018, it was customized from the home edition of Space Invaders.

STEP1 Introduction

A 4-player Score Competition!

A widescreen display let up to four compete simultaenously. This was the first four-player edition in history. It featured three stages: 1) the standard Invaders game; 2) a stage in which the Invaders move both horizontally and vertically; 3) A UFO stage. After three cycles of three stages, a timed UFO level ends the game and goes to a ranking screen.



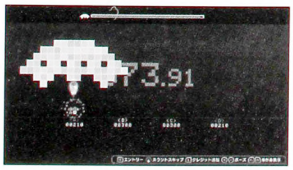
⬆ Players competed for the highest score.

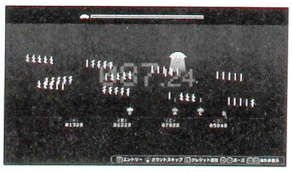
STEP2 Tips

Time your shots to hit repeatedly.

Stage 3 is a special attack together with other players. When your beam cannon is close to that of another player's, a circle appears. If you time hitting the button just right, you'll fire a dual power shot. The more players that fire in synch, the more you'll damage the UFO!

⬇ The secret to success is working together – and practice!





⬆ The UFO really soaks up a lot of damage. Keep firing to take it out.

ARKANOID VS SPACE INVADERS

Arkanoid vs Space Invaders

GAME DATA

Released	Hardware	Controls
2016	Smartphone	Touchscreen

Two Taito All-Time Classics Fuse!

Arkanoid and Space Invaders: two Taito classics. Mixed together, their genes gave birth to a totally new 'invader breaking' game!

STEP1 Introduction

Bounce back the Invaders' shots!

Released as a smartphone game in 2016. Players operate the "Vaus" paddle via touchscreen. Bouncing back Invaders' shots destroys Invaders and blocks. Players must clear all enemies and blocks within the time limit.

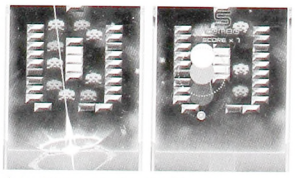
⬅ This is the first game where you can knock Invaders' shots back!

➡ Coins let you buy characters with different skills – powerful allies!

STEP2 Tips

Make use of different shots

Shots bounce back at different angles depending on how they are hit. Also, the more directly beneath a shot you are the harder it hits; a direct bounce-back is returned as a smash. The more you attack the higher the ATK bar goes; fill it and you activate attack mode!

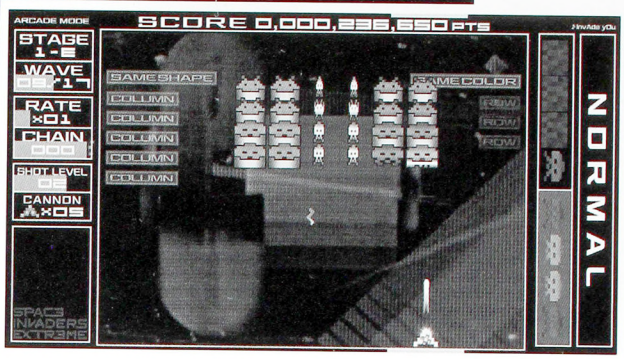


⬆ In Attack Mode, the Vaus turns into a bow that can be drawn back for powerful attacks.

⬅ Bounce from directly below for a super-powerful smash!

SPACE INVADERS EXTREME™

Space Invaders Extreme



Space Invaders & Techno Music!

A major update of the concept released in 2008. A shooting game set to the hypnotic beat of techno music, it provides a refreshing new way of losing yourself in the game.

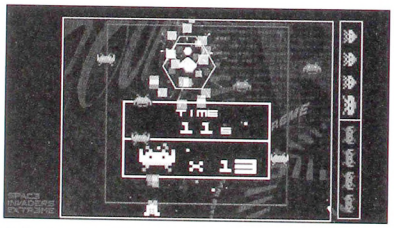
GAME DATA

Released	2008
Hardware	Nintendo DS, PSP
Controls	L/R Movement Buttons + 2 buttons

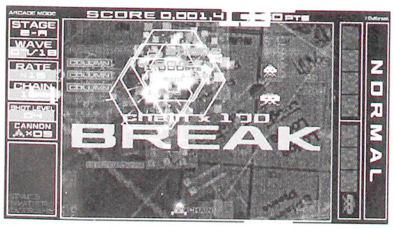
STEP1 Introduction

A new form of Invaders: a music & image sensation.

A revolutionary new take on the concept in which shots are timed to beats in the techno music score. Players bask in the visuals while losing themselves in the soundtrack. The gameplay proceeds along a branching tree of five stages. Each stage's encompasses 17-30 waves, culminating in a boss battle. The version in "Invincible Collection" is based on the Steam version.



⬆ Scenes change with the game play. This is a minigame called "Round". The backdrops also change along with the beat.



⬆ Shoot all Invaders to clear a wave. Multi-hit chains increase your score multiplier.

STEP2 Tips

Hit Invaders of the same color in 2 groups of 4!

When colored Invaders are destroyed, they're logged on the FEATURE panel. When two groups of four same-colored Invaders are completed, a flashing multicolor UFO appears. Shoot it down to activate the ROUND minigame. Clear that within the time limit to unlock FEVER mode and score big!

⬆ The outline above shows a group on the FEATURE panel. Black Invaders are not counted as groups.

Complete set of same color types

Tips!

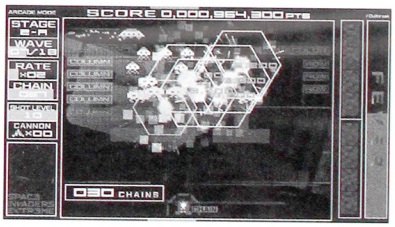
Power Hold for Accurate Attacks

When you want to shoot a specific Invader, having a power up makes this difficult. Pressing L and R together activates Power Hold, allowing you to fire normal shots. This also stops the power gauge from going down, so you can use it to save a power up too.

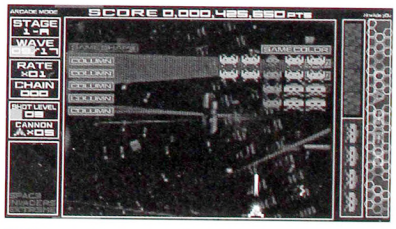
STEP3 Strategy

Trigger a FEVER for high score! How to get an "A" on a stage?

After each stage ends, you; be ranked: S A B C D. Getting a A requires breaking 1 million points. The best way to do this is triggering FEVER mode. To do that, you'll need to make sure to "collect" Invaders by shooting down those of the same color. Once you get the hang of that, start working on timing the appearance of the flashing UFO.



⬆ Aim for high scores by shooting lots of Invaders in FEVER mode. It's a little tricky to trigger, but you can get the hang of it more easily on the first stage.

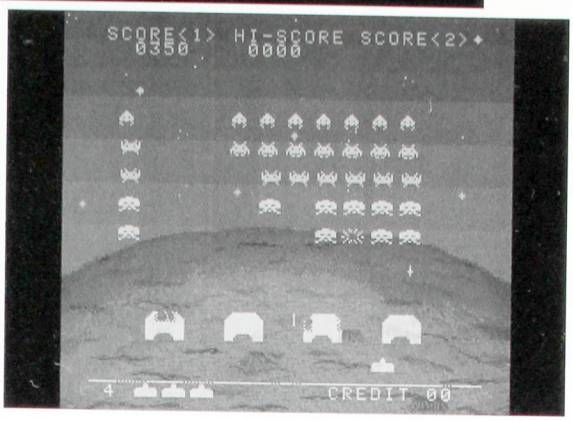


⬆ Waves with groups of same-colored Invaders give you a chance! Don't squander them. You need two groups of the same color to trigger a UFO.

SPACE INVADERS

Space Invaders *DX*

Space Invaders DX



A return of the arcade experience – with head to head play!

As game culture matured in the mid-Nineties, interest grew in classic games. Based on a game developed for the Super Famicom, Space Invaders DX was ported back into an arcade cabinet in a powered-up form, letting players enjoy classic or new versions.

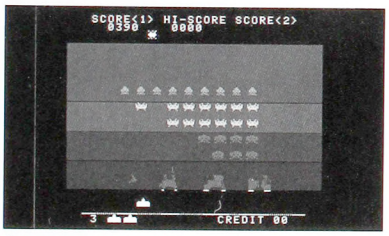
GAME DATA

Released	1994
Hardware	Arcade
Controls	1 stick + 1 button

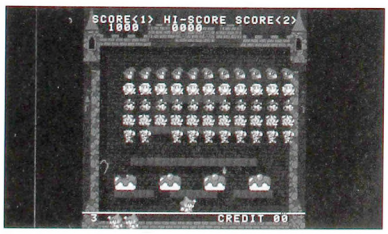
STEP1 Introduction

Three modes, from Retro to Competitive!

The game includes three modes. "Space Invader Mode" lets you play four versions of the classic arcade game. "Parody Mode" is a version featuring characters from other Taito games. "Battle Mode" was the series' first head to head experience. Aside from Battle Mode, all feature the same classic gameplay. The software faithfully replicates the experience of the original, so you can use tried and true strategies.



⬆ It even simulates the colored cellophane used on the B&W monitor of the original.

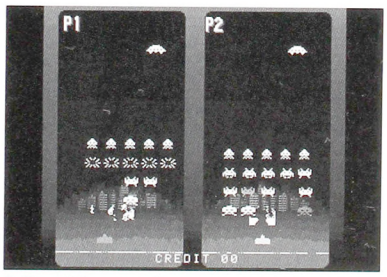


⬆ A Parody Mode stage featuring characters from Fairyland Story (1985). Fight, Ptolemy!

STEP2 Tips

Battle Head to Head Against the Invaders!

A simultaneous two-player mode in which players compete to blast Invaders. When a player clears a row, it appears on the opponent's screen. Shooting each of the 5 colors of Invader triggers special effects that can be used to your advantage. Win by clearing your field of Invaders, or when your opponent is crushed by their Invaders. First to get three points wins.



⬆ The UFO can really turn the tables: shooting it flips you and your opponent's wave of enemies.

Green: eliminates its entire line and adds it to the opponent's field.

Blue: Drops your opponents' Invaders one row down. A pressure-adder!

Red: Drops both your and your opponents' Invaders one row down. A mixed bag.

Yellow: Drops your Invaders one row down. Careful when you shoot these.

Pink: Activates one of the above effects at random. A real wild card!

STEP3 Strategy

Back to the Wall: The Nagoya Attack!

Challenge Mode challenges you to clear specific situations. This one is set to six screens of Parody Mode waves that need to be cleared within 90 seconds. This is a perfect opportunity to practice the famed Nagoya Attack (see p.24), because the Invaders start at a very low level. Just after the stage begins destroy all but the the uppermost left Invader in column 1, then eliminate columns 2 through 5 to make a "safety zone". When the ten-point Invaders reach the lowest level of the screen, scoot yourself all the way right (which will be possible because you'll be invincible because of the Nagoya Attack). Then, work your way back towards the safety zone shooting all the ten-point invaders. Master the technique, apply it to other levels, and score big!

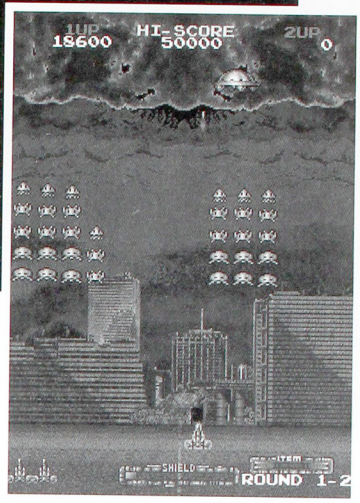
⬅ Wiping out the lowest row in one swoop. While timing your next use of the Nagoya Attack, destroy the edgemost columns.

MAJESTIC TWELVE

Majestic Twelve

SUPER SPACE INVADERS '91

Super Space Invaders '91



Invaders, 90s Style

A new Invader game released at the start of the last decade of the 20th century, re-envisioned with then-trendy features like power ups and boss battles. Released twelve years after the original, it introduced a new generation to Space Invaders.

GAME DATA

Released	1990
Hardware	Arcade
Controls	1 stick + 2 buttons

STEP1 Introduction

The Secret of the UFO: A New Form of Invader

A revival of the concept centering on a then-popular trend of UFO sightings, with updated character designs and levels. It also added power-ups, bridging classic strategy and 1990s gaming style. The Japanese-only Majestic Twelve and the export Super Space Invaders 91 are slightly different, and we'll explore the shared points here.

Power Ups

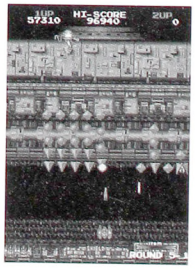
- [F] Fireflower: A burst of flame that envelops multiple enemies.
- [D] Destroy Beam: A laser beam that arcs up the middle for a duration of time.
- [L] Buster Laser: A straight laser beam that can be swept across the screen by moving left to right.
- [H] Hyper Laser: A horizontal beam that wipes out the lowest level of Invaders.
- [P] Player Power Up: Enables double fire. Get it again to enable triple fire. Taking hits reduces the level.
- [T] Time Stop: A butterfly appears and stops the Invaders (and their shots) for a time.
- [A] Arm: Generates four bunkers that also destroy Invaders if they make contact.
- [S] Shield: Adds another shield. A life-saver when you're cornered.

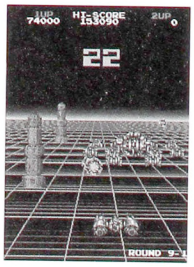
STEP2 Tips

Rapid Fire to Take Out Invaders

The game starts with classic Invaders play, but the backdrops and enemies change with each zone (zones are further divided into 3 stages). It's designed for rapid fire in that you can fire again immediately after hitting an enemy. The columns of Invaders can be easily dispatched simply with the shot button. The power ups are key to strategy. Special attacks can be carried over to the next stage, if you clear the current one within 20 seconds of obtaining them.

➡ Mashing the shot button works well for this stage. But it will take some time before you can fire the next shot.



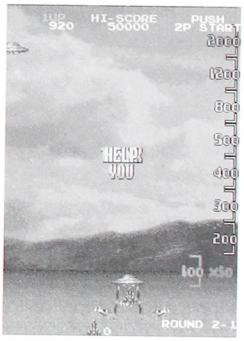


⬅ In the Japanese edition, selecting TURN (alternating 2 player) for PLAY MODE gives you a 3D bonus stage at the end of the 9th round. Three types of enemies attack at random.

STEP3 Strategy

Memorize UFOs for a Perfect Score

Rounds 2, 6, and 9 have "Cattle Mutiliation" bonus stages where you have to protect a herd of cows from being abducted. Save all six of the cows for the top score: 6 x 5000 points, plus a 20000 point perfect score bonus. The UFO patterns are fixed, so memorize them to save the cows.



➡ If you shoot a UFO carrying a cow you'll lose the cow, but you can hit the UFO if you shoot it immediately after it abducts the cow.

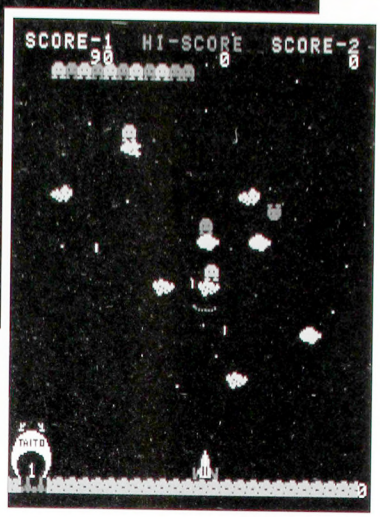
Tips!

Differences Between Japanese and Export Models

The biggest difference is the arrangement of the stages. The Japanese version has five zones for a total of 21 screens (with boss changing if you get to the end without using continues.) The export edition has a total of 43 screens.

SPACE CyCLONE

Space Cyclone



The Legendary Space Battle Returns!

"Space Cylone" might be the most unique entry in this collection. Originally produced in very small numbers, its rarity in arcades led fans to call it a "phantom game". Now, 40 years after its disappearance, you can play it in all its glory!

GAME DATA

Released	1980
Hardware	Arcade
Controls	1 stick + 1 button

STEP1 Introduction

Bug-Cyborg "Bems"! Colorful Screens!

The first thing that stands out is the comical design. The characters are very colorful and animated for their era. The enemy "Bems" are difficult to dodge, so aim for when they're on their "meteors". Your mission is preventing them from reaching the ground and building their enemy rocket base. Destroy all Bems to clear the stage.

Enemy Base. Each Bem builds one level. When it reaches 7 levels, the rocket goes off.

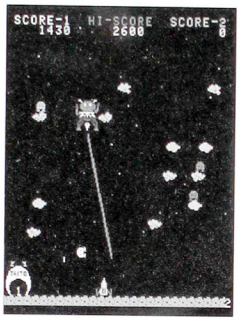
The Bems ride on meteors. There are four colors, but all attack the same way.

When they're on meteors, Bems can fire these wave shots in a second form of attack.

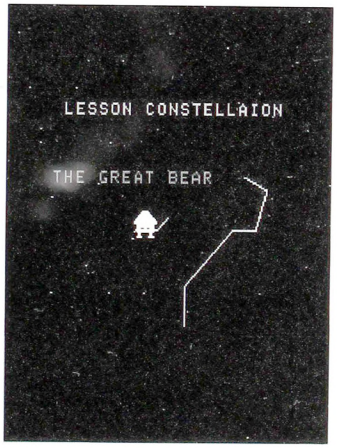
STEP2 Tips

Watch Out for Mass Attacks

Bems descend in random patterns as they attempt to crash into you. They're fast and unpredictable, making it very dangerous to attack them when they drop. It's also easy to get trapped if multiple Bems descend at once. Try to take out as many atop their meteors as you can. At regular intervals, 2 types of UFO appear, and if the base is completed, so does a rocket. We'll get into strategies for these next, but the key is to avoid getting trapped. It's important to watch the whole screen for spots with less attackers to stay alive.



⬅ The enemies are cute but merciless! They attack so fast it's hard to escape. Staying ahead of them is key to making it through the game.

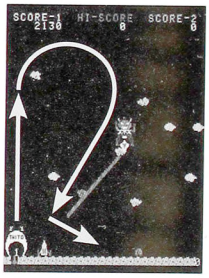


⬆ There are "constellation lessons" at the end of each stage, plus synthesized voices. Hard as it is, this game has a lot of charm.

STEP3 Strategy

Know your Rockets and UFOs!

The strongest enemies are the enemy rocket and the UFOs with lightning attacks. Next are the second type of UFO with fire attacks. They're fast and relentless; study their patterns to stand a chance.

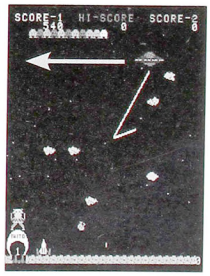


Rocket Pattern

⬅ After launch, it fires three shots that are easy to dodge. It will then move down and left. Shoot it then.

UFO 1 Pattern

➡ Moves horizontally and fires lightning bolts. Just after it fires, move left or right to dodge them.

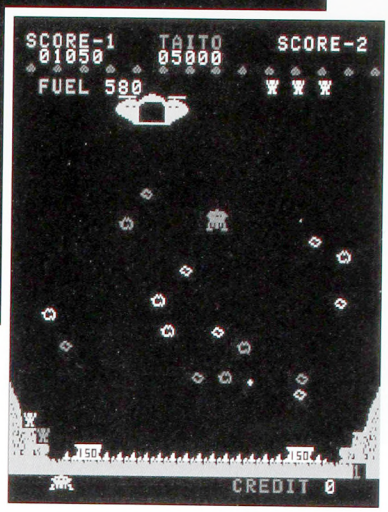


Fireballs Pattern

⬅ The second UFO shoots fireballs that track your movement. Move as far away as you can!

LUNAR RESCUE

Lunar Rescue



A Moonbase Rescue Mission!

Released by Taito in 1979 after the success of Space Invaders. You pilot a lunar lander to rescue astronauts from the moon, avoiding meteors and UFOs.

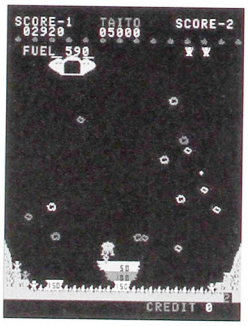
GAME DATA

Released	1979
Hardware	Arcade
Controls	1 stick + 1 button

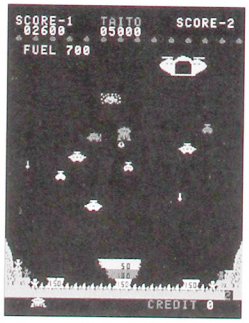
STEP1 Introduction

The Moon is a Dangerous Place

The game has two parts. The first is the descent to the lunar surface while dodging meteors. Once you rescue an astronaut, you have to ascend to the mother ship while dodging UFOs. You can only fire shots on the ascent.



⬆ Descent replicates the low gravity of the moon. Learn how to use your jet to dodge the meteors.

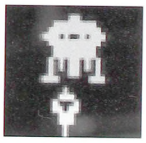


⬆ You'll encounter UFOs during your ascent. Either shoot them or avoid them as needed. Dock with the mothership to save an astronaut.

STEP2 Tips

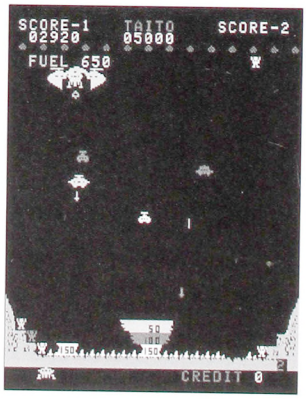
Watch Your Fuel on the Descent!

Your FUEL is indicated at upper left. It's only consumed during descent, and if you use it up you lose. So be careful. You'll also lose if hit by a UFO's shot on the ascent. Until you're used to things, be cautious and aim for the rescue bonus rather than fighting.



➡ The jet slows the speed of your descent. It can also let you adjust horizontal position to land in tight spots.

⬅ Note the FUEL under the score. You aren't given more, so use it wisely!



⬆ Even if you shoot all UFOs, they'll reappear on the next screen. So shooting them is only for boosting your score.

STEP3 Strategy

Clear 3 Missions for a Message!

If you clear three missions, you'll get a message from the aliens. Your main focus should be on survival rather than fighting. The second round is when the meteors and UFOs increase, making fuel conservation even more important. Watch out for sudden meteors during ascent. Either move far to the side and boost up, or drop when you see them coming. A max of three will appear.

Tips!

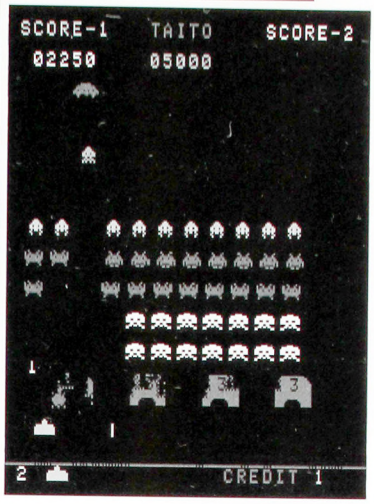
Meteor Patterns are Fixed. Avoid Groups of Them.

The speed and number of meteors increases on higher levels, and you can find yourself trapped between two of them. Their movement is always fixed, as is their interval. So always plan a safe path before beginning your descent.

⬅ Watch for openings before you drop.

SPACE INVADERS PART II

Space Invaders Part II



A Sequel Filled With New Features!

The Invaders are back! Released in the midst of the boom for the first game, Part II featured new tricks and challenges for players devoted to keeping Earth safe from the Invaders!

GAME DATA

Released	1979
Hardware	Arcade
Controls	1 stick + 1 button

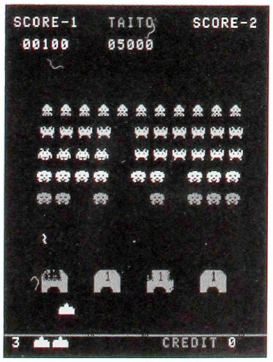
STEP 1 Introduction

A True Sequel to Space Invaders

It's no exaggeration to say the success of 1978's Space Invaders ushered in a new form of leisure for young people in Japan and around the world. At the peak of the phenomenon in 1979, a new evolution appeared in the form of this game. It included new features and new characters such as splitting Invaders and Invaders dropped from UFOs.

⬅The "crab" Invaders that appear starting on the 4th screen break into two when shot.

➡ In addition to the standard UFO a new flashing UFO (500 points) is added. It's very hard to hit.

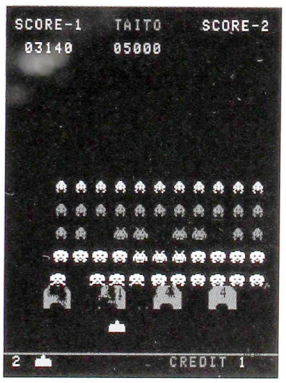


⬆ New animations include the "invasion" of the screen as the Invaders appear. And the bunkers now indicate the stage number.

STEP 2 Tips

Basically the Same Strategy, but...

The strategy is basically the same. Destroy columns 2-4 to create a safety zone. But the Invaders' arrangement changes on level 4. Splitting Invaders appear, and the formation starts lower, making the battle a race against time.



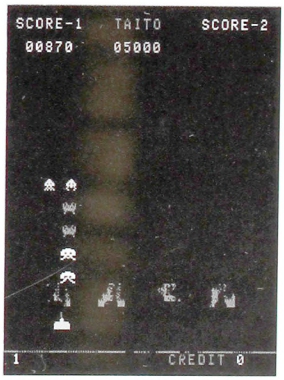
⬆ Starting on level 4, the Invaders' formation changes every two levels. This shows level 4, where splitting "crabs" have been added to the "octopi" Invaders.

STEP 3 Strategy

Use the Rainbow for a Bonus!

If the last Invader left is an "octopus", it will start leaving an afterimage as it moves. This is called the "rainbow", and it's a measure of how well you've mastered the game. Leave one column of Invaders, then take them out while avoiding the last octopus. This gets easier as there are less of them and they speed up. You'll find the Space Invaders Invincible Collection's quick-save and load function handy for practice.

⬅ Succeed and you'll get a bonus of 500 points (1000 if the last Invader was the bottom left one.)



⬆ Try doing it from this formation. It's all too easy to shoot the octopus. Remember, even if you get the rainbow you still have to clear the stage to get the bonus.

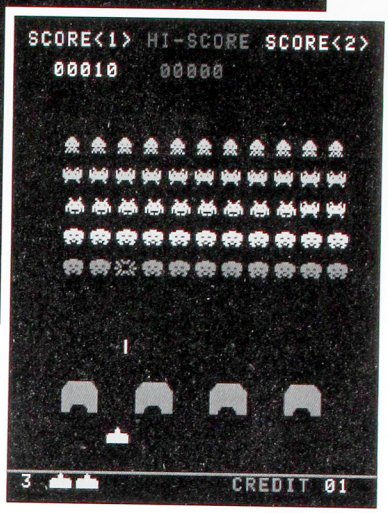
Tips!

Advanced Technique! Secret Extend Mode

If you clear a stage with just 55 shots (the exact number of Invaders!) you'll get a bonus extra life. This is an extremely difficult trick to pull off.

SPACE INVADERS

Space Invaders



1978 : The Invasion Begins!

42 years have passed since the original Space Invaders debuted. By modern standards it seems simplistic, but underestimate the game at your peril. The thrill of mastering the techniques needed to play well is timeless.

GAME DATA

Released	1978
Hardware	Arcade
Controls	1 stick + 1 button

(Data same for B&W and color versions)

STEP 1 Introduction

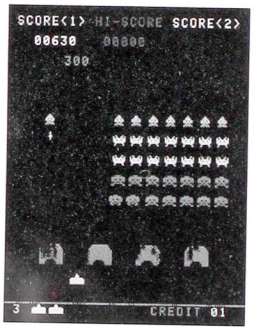
Invaders Arrive in Japan, Sparking a Fever!

Released in 1978, it introduced the concepts of shooting and dodging enemies to an arcade experience that had been dominated by "break-out" style games. Unexpected success developed into a nationwide "Invader phenomenon". The fad spread from young gamers to society at large, earning legions of fans. What follows is an introduction to the very first Space Invaders. Two versions were released: a B&W edition with a 4-digit score, and a color edition with a 5-digit score. The play is identical.

STEP 2 Tips

Shoot Three Types of Space Invaders!

The idea is to shoot all 55 Invaders with as little risk to yourself as possible. First, shoot out the 2nd through 4th columns. This will ensure you a safe zone even as the Invaders continue descending, and also makes it much easier to shoot the UFOs. Then use the bunkers as cover to continue attacking the remaining columns on the right. When you've thinned them out, destroy the uppermost left Invader. Continue the pattern to ensure your effectiveness.



⬅ There are 55 Invaders in three types: "squid", "crab", and "octopus". First, reduce their formation as shown. This is the basic Space Invaders strategy.

STEP 3 Strategy

Get Both UFOs, and 1500 Points a Screen

The highest scoring enemies are the UFOs at the top of the screen. They appear at regular intervals until there are only 7 Invaders left, ranging in score from 50-300 points. The value varies based on your number of shots fired, as shown in the chart. Step up your game by aiming to destroy two 300 point UFOs and getting over 1500 points on a screen. The time to shoot a UFO is your 23rd shot (8+15) or your 38th shot (8+30). Complete STEP 2 with 22 shots. Wait for a UFO to appear, then hit it with your 23rd. Then shoot at Invaders or bunkers up to your 37th shot, and wait to use your 38th on the next UFO. Now you can take your time clearing out the remaining Invaders. If you do it right, you'll wind up with 1590 points (990 for the Invaders and 600 for the two UFOs!)

UFO Scoring

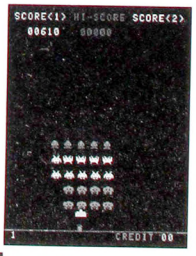
Shot Number	Points
1, 2, 7, 12	50
4, 13	150
8	300
Other (up to 15)	100

(After 16, returns to 1)

Tips!

A Desperate Measure: The Nagoya Attack

When the Invaders reach their lowest point on the screen and come into contact with your beam cannon, it's all over – except for the fact that the Invader's shots will pass through the beam cannon. You can turn the tables by wiping them out quickly. It's called the Nagoya Attack.



⬅ An old-school secret trick! Rumor has it a player in Nagoya figured it out, but nobody knows for sure. It's an arcade mystery.

Check out more tips from Space Invaders champion "fukkokuya" on p.60 !

CHAPTER 2
SPACE INVADERS INTERVIEW

2 INTERVIEW

There are many people whom I'll never be able to repay my gratitude. My mentor as a manga artist Shotaro Ishinomori is one. So too my editor on "Game Center Arashi". Other people I respect include Tomohiro Nishikado, the creator of Space Invaders, and the staff of Taito. Without Space Invaders, "Game Center Arashi" would never have been a hit, nor would I have been able to build the house my friends jokingly call "The Invader Mansion". In fact my life is built on debts of gratitude (I exaggerate a little, but I really am grateful to everyone.)

Mitsuru Sugaya, Creator, "Game Center Arashi"

Behind the Scenes with the Father of Space Invaders

Talking with Tomohiro Nishikado: From the Expected to Urban Legends

Space Invaders was more than a game; it was a societal phenomenon. Japanese game history begins here. Why did developer Tomohiro Nishikado join Taito to make games? Why is Space Invaders oriented vertically? Why did he use a joystick? What about Taito today? Our conversation ranged over many topics. This collection of interviews from four different viewpoints provides valuable insight into the development of this seminal game.

Tomohiro Nishikado

Taito Advisor

Born in Kishiwada, Osaka. Joined Pacific Manufacturing Co.,Ltd., Taito's R&D team, in 1968. Worked on numerous games, including electromechanicals like Sky Fighter, and the Pong-derived Soccer. In 1978, developed the record-breaking hit of Space Invaders.

At first I wasn't interested in games, but rather the audio circuits.

Interviewer: I'm sure you've discussed this to death, but can you tell us how you came to join Pacific Manufacturing[1]?

Nishikado: I was working at an audio company before that. My senior coworker at the time left to join Pacific Manufacturing and when I was looking for a job, I met him and he took me on board. I didn't like it at first.

I: You didn't?

N: I wanted to be an audio designer. I didn't get games. But my coworker took care of me, and I went along with him.

I: You had no interest in games.

N: None. When I asked my coworker what he was working on he said games. At the time, there was this Kansai Seiki driving game.

I: That would be Mini Drive [2].

N: I'd played it in high school at department stores. "If he's working on something like that, maybe it'll be fun", I thought.

I: What was your first responsibility after joining?

N: Mechanical assembly. I spent time in manufacturing, about six months. Even though my original deal was for three months.

I: A sort of apprenticeship?

N: Something like that. After three months it was obvious they'd be in trouble if I left so I stayed there.

I: Then you went straight into development?

N: No, first was inspections, inspecting products.

I: Before shipping them.

N: Exactly, inspections before shipping products. Not of components, but the finished products. I did that, maybe, around six months. Then I went into product tech. They called it the technical department but there was also a development department, and the things that came out of there came to tech, where they

[1] Pacific Manufacturing was a Taito subsidiary founded in Yokohama in 1963. It specialized in product design, development, and manufacturing until it was re-absorbed into the parent company in 1986.

[2] Released in 1959 by Kansei Seiki Seisakusho (KASCO). An electromechanical game that allowed players to "drive" a car with a steering wheel.

were refined and redesigned for mass production.

I: Still no development for you.

N: No, I didn't get to development until around two years after I came on.

I: Was that your goal?

N: You could say that. I was working under a different supervisor by then. A new head of development from headquarters. He liked me, and after a while said, "hey, come over and do development".

I: Headquarters as in Taito?

N: Yes. Pacific Manufacturing was owned by Taito, but Taito had its own technical division, and its division chief came over to Pacific. If he hadn't, I might never have made it into development.

What was the approach to making Space Invaders?

I: What was the general approach to making Space Invaders?

N: Even before Space Invaders, the general idea was one person does one product.

I: As in does everything?

N: Pretty much. One person, one product.

I: That would require some specialized skills, like designing the cabinet.

N: That was different. I mean the game itself. Some people were terrible at graphics and if that were the case would get someone else to make them.

I: Which means there was no head of graphics or anything, just whoever happened to be good at it.

N: Right.

I: I'd think music would require a specialist too.

N: Up to Space Invaders I made all my own sounds. It wasn't high-fidelity music like now, it was beeps. Back then designing a game meant designing hardware, and one person could do everything. That's why I was taught one person, one game. At the peak I think there were three people making games in addition to me.

I: Three!

N: Yeah. That was the era. That was the most. Four people, each working on one game.

I: How many did you make a year?

N: In a year.... Everyone all together, 3 or 4 games. Maybe a little more.

I: So basically one game a year.

N: Well maybe a little more. Maybe one every six months. When I was working on Space Invaders, I worked together with Yasukawa-san, who'd made Blue Shark. And Ishikawa-san, who did Zunzun Block. It was the three of us.

I: In these materials we received from Taito, we saw this list of people involved with Space Invaders. Can you confirm this?

N: Like who?

I: Kazuo Nakagawa-san for the logo and artwork, Michiyuki Kamei-san for sound, Ichimura-san for the joystick, Usami-san and Wakayama-san for the cabinet.

N: Kamei-san is the man for sounds. Ichimura-san definitely oversaw the joystick but I can't recall if he did it all or worked with anyone else. It's possible he came on board for just that time.

I: I see.

N: He said "that was me!" when I spoke to him on the phone, so I don't think the information is wrong. I don't remember the cabinet designer, and it probably was Wakayama-san. When I phoned Usami-san, he said he didn't think he'd been involved.

I: Nobody remembers anymore...

N: That's how it goes. Usami-san said "Maybe I did, maybe together with Wakayama-san", so I think chances are high. But this is how it was; we weren't focused on one game, there were many going through at the same time.

I: I can see that.

Why were both lever and button versions made?

I: I understand that the first 1000 machines used buttons for movement.

N: That's right, buttons. We used buttons during development, too.

I: But the cocktail table type went on sale at the same time?

N: And the cocktail cabinet had the joystick.

I: Why not use the same hardware?

N: Because it's hard to use the buttons with a cocktail table.

I: Okay, so why didn't the upright

cabinet use a joystick? I've always wondered why the parts weren't standardized.

N: Actually, I don't know. I'd have to ask someone from hardware.

I: Ah, so as the software person, that was a different section?

N: I wasn't involved directly but I heard about it. Maybe marketing said "this is a little hard to play", and then it'd become something between them and the manufacturing tech department.

I: Did you concieve of both cocktail and upright machines during the design phase?

N: I designed it as an upright cabinet.

I: I guess that means you planned to use buttons.

N: That's how I was playing it.

I: And the joystick was a marketing request.

N: I think it probably came from marketing. And then someone in product tech would have made it.

I: So you weren't involved in the controls at all.

N: Not at all.

I: Were joysticks common back then?

N: They were definitely around.

I: Already by then.

N: There were horizontal and vertical sticks. Missile X[3] used vertical ones. Joysticks have been around forever.

I: Do you think Space Invaders promoted the use of joysticks in games?

N: Probably. Joystick based games existed before Space Invaders but they definitely increased in number after.

I: Is my understanding right that leaf switch[4] rather than microswitch controlled sticks were more common back then?

N: I used leaf switch types. Or, let me think, maybe I used a microswitch one at first.

I: At first.

N: In the very beginning, in the electromechanical era, it was all leaf switches.

I: Were the joystick units something Taito made in-house, or were they purchased from another maker?

N: Ichimura-san told me of cases of using Atari sticks, so perhaps we looked at those when making them.

I: You looked at overseas games?

N: Yes. We used their basic designs as I recall, but I heard there were a lot of hurdles involving switch functionality, the durability of the springs, things like that.

I: That early stuff broke easily and caused a lot of maintenance headaches, I hear.

N: It did! So we improved it. It was basically just switches and springs.

I: All working in concert together.

N: The structure wasn't very complicated; it was an issue of durability. Ichimura said he fixed it. The basic joystick design was already there.

I: When I looked at the patent office's database, I saw a patent for a commercial joystick dating back to 1968 or so.

N: That sounds about right. The stick came first. Its application in games came much later. They saw it and incorporated it.

Moving blocks... Advancing Game Design

I: Next I'd like to talk about Space Invaders itself. I've heard you cite Breakout as an influence in other interviews. But I don't recall any variations with moving blocks around that time.

N: Right, in Breakout, the blocks don't move.

I: Yet in Space Invaders they do. Where did that idea come from?

N: I guess I just thought it up. When you think about it, the most fun thing about Breakout is that sense of satisfaction from clearing the screen of blocks, one by one down to the last. So I guess I just thought, why not have the blocks move, and add targets, and things like that.

I: So if we say Breakout is the inspiration, more specifically we mean the idea of taking out lines of blocks?

N: That feeling of satisfaction from taking out the blocks, and the satisfaction of taking out that very last one remaining at the end.

I: Where did the idea of the bunkers come from?

N: Those came later; they weren't there at first, and along the way I thought it'd be good to have some way of protecting yourself.

I: So in the very beginning, the Invaders didn't move?

[3] Released by Taito in 1977. An artillery simulator in which players fired a missile at tanks and armored cars in the distance. The missle could be controlled horizontally by a two-way joystick. At the time joysticks were shaped more like simple flight sticks than the ball-topped sticks we know today.

[4] The structure of the switch. Leaf switches are actually a type of microswitch, only differing in the form of the contacts. Leaf switches have a heavier feel than those with light contacts.

N: No, they always moved. In the very earliest incarnation they weren't aliens, they were tanks or something. Because those were the basic enemy in shooting games.

I: Tanks!

N: The idea was a batallion of tanks advancing on you, but the imagery didn't really sell the concept. So I experimented with all kinds of things you'd see in a war, like planes and ships.

I: So it was basically a pure war game.

N: I tried all sorts of things, but didn't find anything that really fit, and that's how they became aliens. At the very end I even tried footsoldiers, but someone told me shooting people was a no-go. I definitely remember that. So I thought, if people are out, let's do something like monsters.

I: So at the time, you could shoot basically anything but people?

N: Right.

I: I guess that's like modern games, where they use zombies or robots instead of people.

N: It's like that.

I: Was the order to avoid people from the president? Or concern about public image?

N: It was the president[5]. But I was told "the president doesn't like that kind of thing" by my section chief or department chief or some superior. It wasn't like the president spoke to me directly.

I: Did you meet then-president Michael Kogan?

N: A few times.

I: What did you talk about?

N: Lots of ideas.

I: For games?

N: Yes, "that idea sounds good", that kind of thing.

I: Did president Kogan like games?

N: I don't know if he played them, but he looked at a lot of them for the business. Especially the American ones; he'd get samples sent so we could play them.

I: He'd go buy these himself?

N: Yes, he'd go to America and buy them directly.

I: I heard Space Invaders was the first Taito game to use an 8080 CPU[6].

N: The first Taito game, yes. The first in history was by Midway[7].

I: Was there any particular hardware you looked at when designing Space Invaders?

N: Midway games mainly. SEAWOLF and Gunfight used the same board so I analyzed them.

I: You mean documentation? Or physically testing the hardware?

N: I had documentation. There were wiring charts, and the boards themselves.

I: Ah, right, they used to include wiring charts for repair.

N: Taito also acted as a distributor[8]. The machines always came with wiring charts.

I: For repairs.

N: Yes.

I: So you analyzed those to help make Space Invaders. I've also heard you set the rows of Invaders to 11 horizontal and 5 vertical rows because of the screen size.

N: That's right.

I: Why did you decide to rotate the TV 90 degrees so it was vertically oriented?

N: I think mainly because because Breakout games used that style.

I: Would it have been possible to make a horizontally oriented Space Invaders?

N: Definitely, but Breakout was strong in my mind, so I did it vertically.

I: Just like that.

N: Yes. Right from the start I knew I wanted it vertically oriented and that I wanted the blocks to be some kind of characters.

I: You had to assemble the code for Space Invaders by hand[9]. It must have been difficult processing the data for vertical display. The bitmap[10] would need to be controlled vertically as well, correct?

N: That didn't occur to me when I was programming it, so when I look at it now, it's hard to understand. At the time I was converting between horizontal and vertical in my head, which was a pain.

I: Was the color version also inspired by foreign products?

N: I went in myself and modified the original into color.

I: Was that difficult?

N: The main difficulty was the expense of color TVs at the time.

I: CRTs were expensive.

N: Color CRTs wEre expensive because the color circutry was complicated.

I: I heard that it was only a few months

[5] Michael Kogan. Born 1920 in Ukraine, he founded the Taito Trading Co., Ltd. in 1953, which later became the Taito Corporation. He died in 1984.

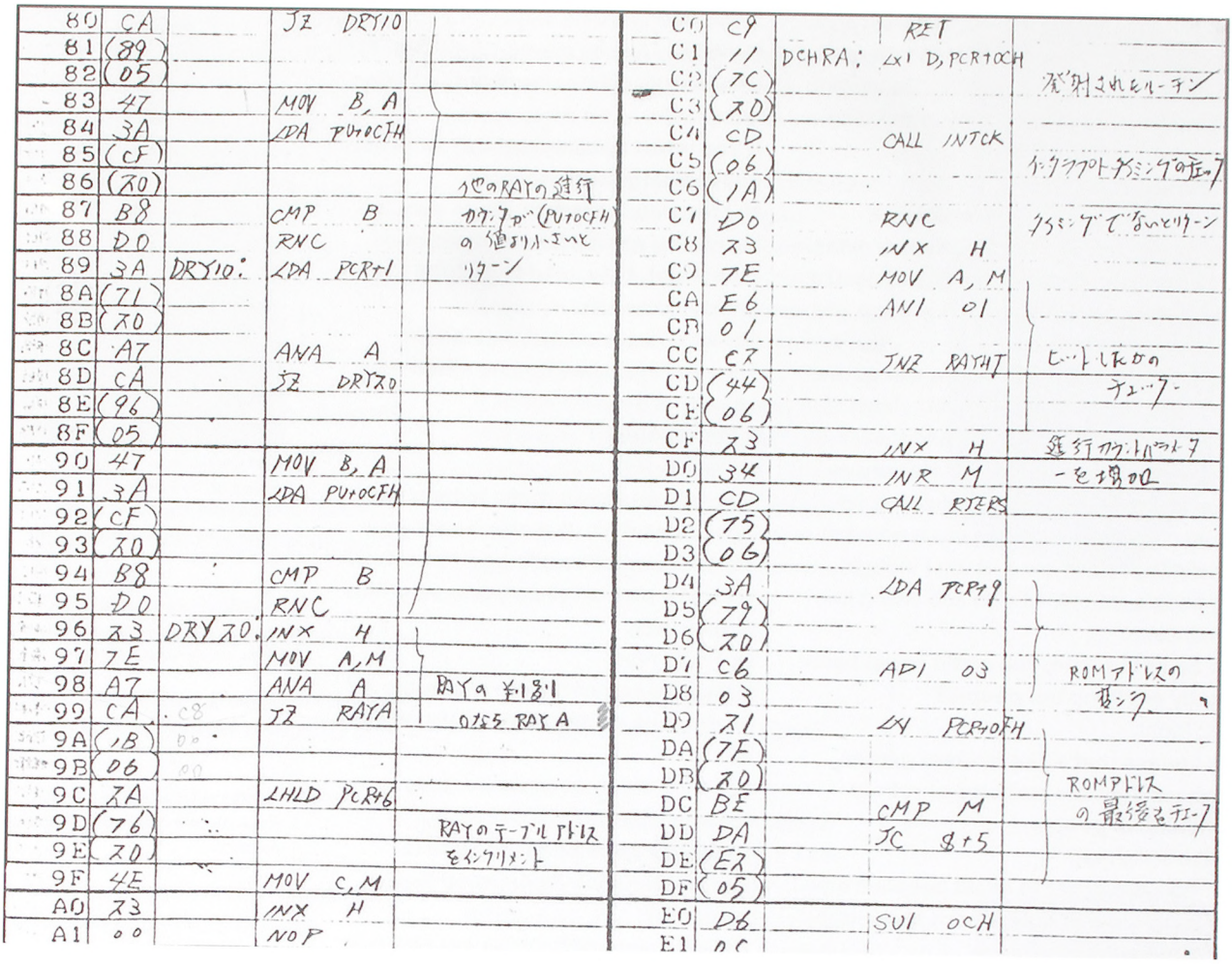
[6] An 8-bit processor released in 1984 by Intel. It was the predecessor of the widely-used Z80 chip.

[7] The 1975 game Gunfight is said to be the first in history to use a microprocessor.

[8] Taito's earliest business was importing and distributing vending machines.

[9] In the end a program has to be formatted so a computer can read it, and this required converting language a human can understand into computer language by hand.

[10] Computer screens are composed of dots (pixels), and Space Invaders screens had a resolution of 256 x 224 dots. This usable display range is known as a bitmap.



⬆ A portion of programming written by Nishikado for Space Invaders. At left is machine code for the computer, at right is assembly language for humans to read. Note the annotations at far right.

from its conception to its release.

N: Yeah, it took me about two weeks to come up with the circuitry.

I: What was the coloring technique?

N: The circuit was designed to color the characters on the hardware side. The idea was inspired by the cellophane over the screen. The circuit was designed around that idea.

Already a Specialist in Digital Circuits and TVs

I: IC and LSI chips were rapidly evolving at the time. Did you feel pressure to master the latest technologies?

N: It was my first time working with logic chips[11], so I had to study up on that. On the other hand digital circuits were something I'd studied in school so the hurdle was a lot lower.

I: What about the monitor? Monitors use high voltages so I'd imagine that would pose difficulties.

N: I was actually pretty knowledgable about TVs.

I: A specialty of yours?

N: I took courses at a specialized TV school when I was going to college. I did some TV repair, too.

I: TV was evolving pretty rapidly at the time, too.

N: That was the pinnacle of technology for electronic circuits. When I was a student I did part-time work as a TV repairman.

I: So it was a specialty.

N: You could say that. Initially I modified commercial sets, adding video inputs so you could display things on them.

I: You took apart and rebuilt TV sets?

N: This was the Pong era. The original Pong used a normal television set. I'd made Soccer based on that, and while I wanted to put it on monitor I could only get consumer TV sets, so I bought those and modifed them with video inputs.

I: You must have had lots of empty TV set housings lying around.

N: Definitely, but really, it was only for the

[11] A component of a logic circuit array. Logic arrays are circuits that return a specified function when a signal is input. In combination they can calculate values; in large combinations they can run programs.

first few cabinets. Once it went into mass production the manufacturer did things right.

I: Next I'd like to ask about sounds. You mentioned earlier that this was an era of beeps and buzzes, and you wanted to make something more. And you did, in the marching beat, almost a melody, of the descending Space Invaders. How did you come up with that?

N: Kamei-san designed the sounds. I gave them to him because he said he wanted to do it. But I directed the "march". I specified the scale, the frequency, and that I wanted him to use a deep sound. The rest I left up to him.

I: Why a deep sound?

N: The idea was of this approaching, footstep-like sound.

I: And there was the theme from "Jaws", too.

N: I guess it resembles that, but it wasn't on my mind. Just a deep zmm-zmm-zmmm thing as they approached.

I: So for that Invader sound, you knew what you wanted from the start.

N: Yes. He told me later it was really a tall order, because the lower a sound you generate the more the speaker cone resonates when you raise the output. He really did a great job with it.

I: On the other hand, the UFOs have a higher pitch.

N: They do, and I always thought that was good. What I never liked was the shooting sound.

I: It's a sort of "pshh" sound.

N: Never liked it from the start.

I: It sure sounds that way (laughs).

N: Maybe more like, I wished it were a little deeper of a sound.

I: A little more impact?

N: Right, like more of a "boom".

I: Like a cannon?

N: Exactly, it sounds too high, like one of those Chinese trumpets you see on the wall of a ramen shop. Kamei-san got mad when I said that.

I: That's an engineer for you (laughs).

N: That's an engineer. He took it pretty personally as I recall. I kept asking him to fix it and he never did(laughs).

N: So it stayed that way.

I: How old was Kamei-san at the time?

N: When he was working on Space Invaders, I think he was about 20.

I: A little younger than you, then.

N: Yeah. He was a new hire.

I: I can imagine a 20 year old taking it personally.

Invading a Penny Candy Store

I: So this is more of sales side question. Did you ever buy a machine for anyone, or ask Taito to send one to anyone?

N: I bought one for my mother.

I: Your mother! (laughs)

N: My mother ran a penny-candy store in Osaka's Kishiwada. She asked if she might be able to get a Space Invaders machine. At that moment nobody could get their hands on one. I spoke to the sales director and he said he'd sell me one as a favor. Later I heard from my mother that the salesman who showed up grumbled about having to send a machine to such a little shop in the middle of a shortage. I don't think she mentioned I'd ordered it.

I: So you didn't tell anyone else in the company that it was your house.

N: And the sales director kept it to himself, too.

I: The staffer must have wondered why he was being ordered to serve a penny candy shop (laughs).

N: Right, at this point he didn't have enough machines to sell, so why give this place priority? But it wasn't cheap. My mother was surprised that they didn't give it to me for free since I created it.

I: I can see that.

N: Well, I did get a little discount anyway.

I: That must have been the first penny-candy arcade placement for Space Invaders.

N: Probably! Manufacturing couldn't keep up with demand at the time.

I: Another sales question: it was simultaneously sold as both cocktail and upright cabinets. Was that common for games at the time?

N: Well, the cocktail cabinets were common, Breakout used them.

I: With both types sold at the same time?

N: Actually I think the uprights came first.

I: When did you personally become

aware of cocktail cabinets?

N: As far back as Breakout.

I: Chairman Ishii claims Taito was first to make them.

N: Ah, that's right. When we looked into it it seemed a Taito design was the base model. Base model or not, cocktail types were developed for block games.

I: Basically incorporating an upright's circuit board and the monitor into a table?

N: I'm not sure who designed the first one.

I: So it's unknown.

N: Yes. But I do think Taito was first.

I: We call them "table cabinets" in Japanese, but they're "cocktail cabinets" abroad.

N: Yes, because you could set your cocktail glass on them. While you played.

I: That was where the idea came from.

N: I think so. That was the original idea.

I: Presumably the most Space Invaders machines were manufactured at the peak of the fad. Where were they made?

N: At a subcontractor.

I: Were there many subcontractors?

N: Yes. They weren't made in Taito's factories like the one in Ebina[12]. Maybe they were brought there for testing.

I: So Taito didn't manufacture many.

N: When I first joined, they did, but later, manufacturing was all outsourced. I heared they had to rebuild into a much larger facility to handle demand for Space Invaders.

I: They had to rebuild.

N: They were making a lot of profit so they built it in anticipation. But I think things got tight afterwards.

I: Like after the boom faded.

N: There were a lot of manufacturing problems during the boom. Staff barely had enough time to sleep.

I: And parts delivery too, I'm sure.

N: Taito always had a strong pipeline abroad, so I don't recall us struggling with parts, but I heard there was a global parts shortage going on at the time. And without parts you can't manufacture. There was one component, the 74241 chip[13], that we couldn't make anything without, that people were talking about "241 bankrupcy". Though truthfully the design could have been modified to work without it.

Announcing Space nvaders

I: I've heard that Blue Shark got more attention at the trade show. Did that get back to you?

N: Of course. Sales called me right away with the results of the show.

I: On the phone.

N: I didn't go to whatever it was, a show or an event or whatever.

I: What did you feel?

N: "I figured as much".

I: Really?

N: Definitely. I thought Blue Shark was the better game from a play standpoint, with the timer.

I: Easier to understand?

N: But honestly, I didn't worry too much, because the people around me, the development team, enjoyed it.

I: So you knew it was interesting.

N: The young sales staff was worried about which game to put its weight behind too. "I think it's going to go big, or fail big", someone said.

I: That's how it is with new things.

N: Yes. That's why nobody knew which would hit.

I: Am I right that it didn't sell well at first?

N: Yes. I heard there weren't many orders at first.

I: Obviously that changed, but when did you sense it?

N: I'd say within a month after launch.

I: That's fast.

N: We got word from an arcade in Kamata that their machine was eating coins. This was within two weeks of its debut. So I went there to fix it. The machine was malfunctioning, but I also heard from staff that it had been doing pretty well, too. Fortunately we fixed it quickly so it didn't turn into a problem. But that's when I started sensing it was selling.

Space Invaders' Legacy

I: Did your life change at all after Space Invaders hit big?

[12] Operated as a Taito manufacturing facility from 1979-2001.

[13] A logic chip.

N: It was good for me at work. I was promoted from unit chief to section manager. In my personal life nothing much changed. I didn't really talk about it much.

I: What about your family, your wife?

N: I didn't talk about it with my wife.

I: You didn't? She must have known about Space Invaders, though!

N: Maybe from TV?

I: It was pretty widely covered in the weeklies.

N: Oh, I'm sure she knew of its existence, but she didn't play.

I: So she had no idea you made it?

N: No. She wouldn't. I didn't say anything. I thought that was better.

I: (laughs)

N: There was no need. She probably read about it in a magazine.

I: So you only got a little raise when you became section manager?

N: I actually got a pay cut.

I: Oh, because you weren't getting paid for overtime? (laughs)

N: Right. So it went down.

I: What about a bonus?

N: I got a bonus, but nothing out of the ordinary. People whispered about how I must have gotten a stack of bills this thick, but that wasn't true.

I: (laughs) So you just didn't want to tell anyone you'd made Space Invaders?

N: No, I didn't, and the company never announced my involvement.

I: So you just aren't the type who craves the limelight.

N: Not at all. Almost zero (laughs).

I: You just liked making games.

N: Exactly. Though it seems strange, looking back on it now.

I: In other interviews I've conducted, when I ask "what did the Invader boom mean?" I often hear that it was like a Big Bang, the point where games really started. How do you see it, personally?

N: I see it that way now, but back in time, I didn't. It took about a decade for me to realize how much much Space Invaders grew the industry. At the time I thought it was a decent hit, but nothing special. That it would probably fade away.

I: But by the winter of '78, you must have seen Space Invaders machines all over the city.

N: I did. I'd hear that annoying sound, it hurt my ears (laughs).

I: You really didn't like that sound effect! (laughs) But how did you feel at that time? Good?

N: Well, I didn't feel bad, but at the time I didn't really go to arcades myself. In fact, I never saw an Invader room.

I: So you never saw people losing themselves in it, even though it was such a fad.

N: No. I heard about it from TV, or people around me. Because I never went to arcades.

I: Because you were young?

N: Maybe. Also, it was done as far as I was concerned. That's an engineer for you, I guess.

I: Like your story about Kamei-san taking it personally. That's an engineer's stubborness.

N: That' right. When Space Invaders was completed, I was done. I started thinking about the next thing.

I: I know it's been asked before, but in closing, what is Space Invaders to you?

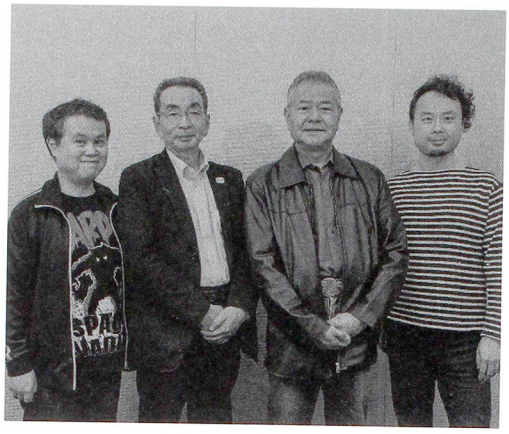
N: There are several key titles that expanded the Japanese game industry. Pong was one. I think Space Invaders was a second. Looking back, I'm happy I was able to make that contribition. Even if I didn't see it that way at the time! (laughs)

⬇ June 16 is officially registered as Space Invaders Day in Japan. June 16, 1978 was the day of the event where Space Invaders was publicly announced.

How Taito Sound was born...

Interview with Michiyuki Kamei and Yoshio Imamura to celebrate the release of "Space Invaders Invincible Collection"

Writer: hally, Photography by Yusuke Masuda



"Space Invaders" is a title that has been spoken about many times in the past, not only about the game itself, but also about the significance and attractiveness of its sound. However, there's still a lack of accurate information available as to what "Space Invaders" means for Taito and how it influenced the sound of ZUNTATA in subsequent years.

In order to clarify these points, we asked Michiyuki Kamei, who is the creator of the "Space Invaders" sound, and Yoshio Imamura, who was the first director of Taito's sound development division (later ZUNTATA), about the state of production at the time, in terms of software and hardware. Katsuhisa Ishikawa and Shohei Tsuchiya who are currently at ZUNTATA are also present for an interview that connects the past and the present.

Michiyuki Kamei

He joined Taito as a production engineer and was in charge of power supply design and sound, as well as being responsible for the sound circuitry of "Space Invaders". He has been involved in hardware design and development for a long time, and in the later years, he developed controllers for games such as "Densha de GO!" while serving as General Manager of the Console Division.

Yoshio Imamura

He established the sound department of TAITO, which later became ZUNTATA. He created the sounds for "Chack'n Pop" and "Elevator Action" among others.

Katsuhisa Ishikawa

He is currently in charge of ZUNTATA and works on sound direction and SE production. In recent years, he has also been an active spokesman for the ZUNTATA brand.

Shohei Tsuchiya

A current ZUNTATA member, he is responsible for the sound of the title screen and menu screen of "Space Invaders Invincible Collection". He was also involved in "Space Invaders GIGAMAX". On 1 April, 2020, the second volume of his works, "SHOHEI TSUCHIYA WORKS Vol.2", was released as a digital download on iTunes and other sites.

Fanfare of the "Super Speed Race" that marked the dawn of the TAITO music.

4Gamer: Mr. Kamei, you joined the company in 1976, so do you remember your first work?

Michiyuki Kamei (Kamei): I wonder what it was ... I remember "Lucky Dice" (medal game, released in 1976 in Japan) and "Block" (released in August 1977 in Japan). think I was involved with "Fisco 400" (released in April 1977 in Japan) too?

Yoshio Imamura (Imamura): "Gunman" (released in October 1977) is definitely your work.

4Gamer: For which titles do you remember precise work details?

Kamei: There's "Super Speed Race" (released December 1977 in Japan). We wanted to make a gorgeous fanfare at the finish, but I couldn't read musical scores, so I asked Imamura-san, my junior-colleague who was older than me... come to

*This interview took place in the first half of March 2020.
*The text contains some of the author's research.

think of it, I didn't call him Imamura-san at the time.

Imamura: We called each other "Kame-chan" and "Ima-chan" (laughs).

Kamei: Yes (laughs). And when I asked Ima-chan about it, he told me that I could make a fanfare with the four notes Do, Si, La and Sol.

Imamura: I taught him the easiest one because the number of sounds was limited.

Kamei: At the time, games didn't have a CPU yet, so we had to build a circuit for each note and adjust it so that it would have a specific pitch. We wrote the notes in the ROM, but we didn't write the score, did we? We were ordered like "make it like so" (laughs). Did we have a planning document or specifications sheet or something then?

Imamura: I think we had a rough draft?

Kamei: Also in "Space Invaders" Nishikado-san (Tomohiro Nishikado, the well-known developer of "Space Invaders") came from his development room on the fourth floor and just said, "Add the sound for this game(laughs)".

Imamura: The first thing all new employees had to do was draw schematics. We'd make neat copies of the circuit diagrams our seniors had made on graph paper so they could be filed after development finished.

Katsuhisa Ishikawa (Ishikawa): Imamura-san, were you in charge of the hardware at the beginning?

Imamura: That's right. Kame-chan and I were both in a department called "Production Engineering".

Kamei: Ima-chan seemed to be able to draw well, but I couldn't draw neatly and my handwriting is not very good, so I was told, "That's enough. You don't have to draw anymore" (laughs).

Imamura: So you started doing sound pretty early on, right?

The birth of TAITO's first sound designer.

4Gamer: How did you come to be in charge of sound at first, Kamei-san?

Kamei: Actually, I wanted to put a siren on my car. At the time it was all the rage for biker gangs to modify their vehicles. So, I also bought a red trumpet-type speaker and a circuit board to put on my car, and was adjusted them during my lunch break to make them sound. My boss saw this and said to me, "How about being a sound creator?". I answered, "No, I've never made a sound circuit before" but he said, "but you're making it now" (laughs). So that's how I started doing it.

Shohei Tsuchiya (Tsuchiya): That's all it took for you to give it a try? That's amazing (laughs).

Kamei: And he said, "No more drawing circuit diagrams" (laughs).

Imamura: When I joined the company, Kame-chan was already doing sound effects.

4Gamer: By then, it was already "Kamei-san is in charge of sound", wasn't it?

Kamei: That's right. I was the only one there. I was also in charge of the power supplies, and I designed them by myself too. In those days, boards used a lot of power, so I had to make a "power supply board" like some sort of "monster transformer".

4Gamer: Did you major in that when you were a student?

Kamei: No, I studied radio engineering, so it had nothing to do with that. Dare I say, I'd dealt very little with analog circuits before. I hadn't even used a computer yet, and the first one I used was the TK-80[1]. So it was after joining the company.

4Gamer: Had you used a synthesizer at that time?

Kamei: No, I hadn't. I had always been thinking that I wish there was something which could make some kind of sound. I think they finally bought a synthesizer for us when we started ZUNTATA, didn't they?

Imamura: No. It was the first time we got a Roland SYSTEM-100, in order to raise awareness of the synthesizer among the sound people.

Kamei: I saw it in the sound department and thought, "That's great, I wish I'd had one of those...".

Ishikawa: Did you make any audio amplifiers when you were a student?

Kamei: Oh, I liked making amplifiers. However, I don't think the things which I studied have helped me at all. When I joined the company, I learned a lot of things by looking through various materi-

[1] Intel/8080-based single-board computer kit developed by Nippon Electric Company (NEC) in 1976 August.

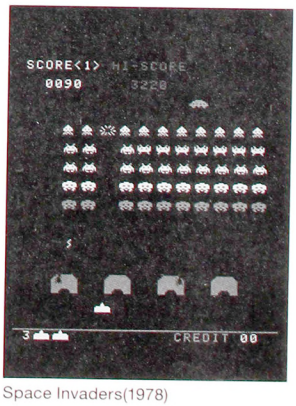
als and books.

The reason why they wanted to join Taito when games were not yet common...

Tsuchiya: I have a question for both of you. Why did you join Taito?
Kamei: I wanted to work in a company that manufactured something. I had no specific image, but I enjoyed making things. In fact, when I joined Taito, we had several jobs and could make anything we wanted.
4Gamer: That means, Taito had an environment where you could try out different things?
Kamei: Yes. I was absorbed in making sounds, power supplies, whatever it was. But to tell you the truth, I didn't really like playing games, even though I would have been fired if I had said so at that time (laughs). Rather than making games and enjoying them, I liked to see the people enjoying the games I made. That was also my motivation when I made the controller for "Densha de GO!"
Tsuchiya: Well, you're quite an eccentric person, aren't you? And it's very different from the young people of today, who create game music because they love games. How about you, Mr. Imamura?
Imamura: When I was a university student, I was doing research on optical fibers.
4Gamer & ZUNTATA: Wow!
Imamura: My major had nothing to do with games at all and I was doing something pretty logical. But maybe because I was doing such a serious thing, I came to think that if I had a job, I wanted to find an office that wasn't too formal and where "fun" was part of the business. If there was a Disneyland in Japan at that time, I would have wanted to join there (laughs). Also, my hometown is Yokosuka, so I wanted an office that wasn't too far from there. When I was looking for a job under such conditions, I found Taito near Tsunashima. So, I applied to Taito, but when I joined Taito, I realized they weren't really in Tsunashima at all, 'cos the bus took me further and further away from there (laughs). That was a miscalculation, though. So I didn't really want to make games, and I wasn't good at playing them either. I've only been able to make the rounds in "Space Invaders" just once in my lifetime.
Tsuchiya: However, you must have had a lot of fun when you joined the company and started making games and play equipment, right?
Imamura: Living in the world of techies, of course, it was fun to make something out of nothing. But after all, it wasn't just the games that were special.
Tsuchiya: I guess it wasn't so much games, but a just a desire to create something.

Who was the first person to add sound to the first Taito game in the early days?

Tsuchiya: I thought that Mr. Kamei was the founder of Taito sound. But in fact, there were games with sound even before he joined the company. That means that some of Mr. Kamei's senior colleagues were also making sound.
Kamei: Well, I didn't have any contact with those people at all. They didn't tell me how to do it. I later learnt that my senior colleagues used to make sounds like "beep" or "boo" by using the low frequencies used to display images.
Tsuchiya: Although there were other people who made sounds before that, you were the first to specialize in it, weren't you, Kamei-san?
Kamei: In the beginning, one person was in charge of one project and made all the circuits, but gradually the necessary circuits became more complicated and it became important to divide up the works. I guess I was also in the beginning of such a generation. If Mr. Nishikado wanted to do that by himself, I think he could have made the sound. Because he has a wide range of abilities, he can play the guitar and has a good sense of sound. But at the time of making "Space Invaders", I don't think he had time to devote to music anymore, and he had to think more about the game itself.
Imamura: Put another way, except the sound, Mr. Nishikado made everything for "Space Invaders", even the design of the dot-art.
Kamei: The development environment was also the same. He unpicked the contents of marker pen and made a light



Space Invaders(1978)

pen. There was only one computer in the company at the time (an Intel development tool, the Intellec MDS-800), but Mr. Nishikado let other young people use it. And he built his own development computer and built his own environment where he could store data in a magnetic tape recorder. He also made his own monitor program (input / output management program).

Imamura: The person who used the only computer in the company made the "Blue Shark[2]" and "Space Cruiser", he was like a disciple of Mr. Nishikado.

4Gamer: They were using commercially available computers in their development, weren't they?

Imamura: Of course, it was not possible to create just using computers, so it was necessary to use an ICE in between (In-circuit Emulator. You can control an arcade board directly from a PC by inserting it to the CPU slot).

Kamei: For "Blue Shark" we used Midway's circuit boards, and we developed game software and sound circuits in-house.

Coexistence and co-prosperity and the relationship between Taito and Midway

4Gamer: It's known that the Blue Shark and Space Invaders boards were very similar to the base constructions of the Midway board. Did you use Midway's board as a reference?

Imamura: No, we were licensed. The first one we got was "Ballpark" (released May 1977. "Tornado Baseball" in English), right? It was the L-shaped board. I used one from Midway for what we'd call a motherboard today, and I made the game board by myself.

Kamei: We made an even better one by referring to the circuit board that came from Midway. And we licensed it out to them. At the time Taito and Midway had a very good reciprocal relationship...

Imamura: We were also very similar to each other regarding flippers (pinball).

Kamei: That's how the technologies of both companies came to be combined. Mr. Nishikado also visited Midway, though I don't think any Midway engineers ever came here (laughs). We didn't receive any development equipment from Midway, so that's why Mr. Nishikado made his own equipment.

4Gamer: The board of "Space Invaders" was a great expansion of the board designed by Midway and extended by a sub-board. That kind of development was also a benefit to Midway as well, wasn't it?

Kamei: I think so. It couldn't be handled just by the Midway board as it was. The CPU wasn't powerful enough to move so many characters around. We needed to incorporate a circuit called shift register, and Midway did not have this technology. Midway's CPU-based system and Nishikado's video game technology, which he had cultivated with TTL (logic circuits that combine transistors and resistors), were combined to create Space Invaders.

The sound of "Space Invaders" was created in a hurry.

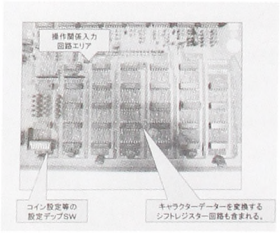
4Gamer: When "Blue Shark" and "Space Invaders" were being developed in parallel, you were in charge of sound for both. Actually, I heard that "Blue Shark" was the more important one.

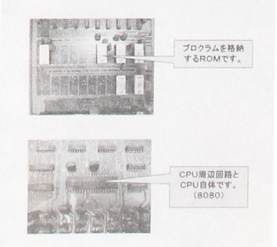
Kamei: I was told to do "Blue Shark" first, and I was working on that, for example, the sound of moving octopus. I think that was, uh... that was around April or May in 1978. At that time, you were already at Taito, weren't you, Kamei-san?

Imamura: I was doing my best to draw circuit diagrams, while wondering 'what on earth is he doing?' (laughs)

Kamei: Around that time, Mr. Nishikado came to me and asked me to make sound for Space Invaders, and I ended up working on that at the same time. But I didn't have much time to meet the deadline. June 16th of that year... the day now officially registered with the Japan Anniversary Association as "Space Invaders Day", but both "Blue Shark" and "Space Invaders" were going to be unveiled at a private show, and I had to finish the sound by then. The sound of "Blue Shark" was completed right on time. But I didn't have enough time for "Space Invaders", so I decided to re-use one part of the sound circuitry from "Blue Shark".

[2] "Blue Shark" was released in July 1978 in Japan. It was developed at the same time as "Space Invaders", and the sales department were expecting it to be the greater success in terms of sales. "Space Cruiser" was released in September 1981 and an arrangement of Mussorgsky's "Night on Bald Mountain" was used as the background music. Both are arcade shooting games.





4Gamer: So, both sound circuits are fundamentally the same? They sound so different though.

Kamei: If you change the resistance or the timing of switching sound, the atmosphere can change as much as you want. I learned this feeling by continually adding and removing parts on the board. In "Blue Shark", there are creatures like octopuses and sharks, so I made sounds based on these images. Actually, there is no sound when the octopus is moving, but I tried to express that nimble movement.

4Gamer: The shot was like a sound of water too.

Kamei: But "Space Invaders" has a completely different world view. And when I saw the screen, my first impression was "cute". So even though I used the same circuit, I adjusted it (replacing resistors and capacitors) so it would sound completely different. For example, the sound of shooting a bullet is different between "Blue Shark" and "Space Invaders". Because the former is a short distance in the water and the latter is a distance in the air. So the sound was raised accordingly, and the length of time before the sound disappears was also adjusted.

4Gamer: In a recent interview (see p.31), Mr.Nishikado said that he wasn't satisfied with the high-pitched sound of the shot, and he asked you to fix it, but he had trouble convincing you.

Kamei: I really wanted to differentiate it from "Blue Shark". When we were on a talk show together in the past, Nishikasho-san also said that it was a very memorable sound in the arcades at that time, so it was a good result.

4Gamer: The sound circuitry for the shot has the most parts, like the hit sound, so there's a lot of attention to detail.

Kamei: We used a lot of parts. I don't know how long it took... I don't know anymore because we didn't write a daily report or anything at that time (laughs).

Imamura: Oh, I've never written one before, either.

Ishikawa: There was a time when you didn't have to write daily reports!? I'm so jealous (laughs).

Kamei: It can't have been very long, because I was making the sounds while looking at the game. When the graphics are already done, it means the system is ready, and the schematics have already been drawn. I think it was probably around the time when Ima-chan was neatly re-drawing the disparate drawings (laughs). I took them to the circuit board design shop, put the parts on the finished board, and checked the operations... I did this with some of my senior colleagues. I don't think we decided to show "Space Invaders" until after "Blue Shark" was confirmed for the event and even then it was only an afterthought. That's why we had to hurry to get it ready.

Ishikawa: "Space Invaders" was just an "incidental" thing at that point, wasn't it?

Kamei: Yes. As Mr. Nishikado has said several times, in the beginning of development, he didn't let his bosses see the screen. If they'd have seen it before he had time to polish it up, they'd have been telling him to make it like this and that, nothing would have gone well, so he made a switch to turn off only the TV screen. Because the screen was turned off, they still thought he was making a development tool. That was just how it was back then.

4Gamer: In the days of "Blue Shark" and "Space Invaders", what was the budget like for making sound?

Kamei: We didn't do any budget management at that time. In fact, the sound circuitry of "Space Invaders" is quite extravagant, and there are even things that are unnecessary. For example, each of the seven sound outputs has its own volume control. Yes, it was nice to be able to make minor adjustments, but I couldn't help thinking it would have been more economical if we just had one control for all of them. But the prototype board went into mass-production as it was, and there was no time to improve it after that, and my boss didn't see that as a problem.

4Gamer: So, there were no instructions or restrictions on the number of parts?

Kamei: No. So when Texas Instrument approached us about using the SN76477 (one of their earliest sound chips), they gave us one as a sample, which I could use simply out of interest. SN76477 is used to make the sound of UFOs.

4Gamer: Space Invaders was the first arcade game to use the SN76477... or rather the first arcade game to use a

sound chip itself, but that's because it was such a free environment.

Kamei: I used the LM3900 (an important IC for analog sound circuits) quite a lot. So, I wanted to use something else as well. Even though we didn't care about the budget, the SN76477 costs only twice as much as the LM3900, and its smaller package, which is called Shrink DIP also saves on circuit space. I thought it would make things a lot easier (laughs).

Ishikawa: The sound of the UFO actually oscillates on the board all the time. When the UFO comes out in the game, it's just opening and closing the exit of the signal.

Kamei: That's right. We catch only the on/off signal from Nishikado's game program. The SN76477 is not a programmable chip, so in that respect, I was using it in the same sense as the LM3900.

4Gamer: How long did it take you to create the sound for "Blue Shark" and "Space Invaders"?

Kamei: I remember making it when I had a cold and a runny nose, so I think I started doing it in the cold season (late 1977 to early 1978). The show was in June, so it took four or five months at most.

4Gamer: How did you create the sound for "Space Invaders"?

Kamei: At first, there were no conductive traces for sound on the board at all, just a lot of through holes (it was a so-called "breadboard"). Only the amplifier was on it, and the rest of the parts were connected with wires. Before the show, I showed Ima-chan and our bosses my messy diagrams, and asked them to make five each of table and upright cabinets, for a total of about ten.

4Gamer: Does Space Invaders follow the sound circuitry of past titles in some respects?

Kamei: Yes, that's right. For example, Invader's "Do, Si, La, Sol" marching sound was originally made with a circuit that produces the fanfare pitch of "Super Speed Race" and uses the same mechanism (timer IC 556). It's tuned with ±1% resistance so that the pitch will match. Ima-chan did this job.

4Gamer: The marching sound was at a higher pitch in the beginning, right?

Kamei: At first, I was making a comical sound like "pi, po, pa, po". However, the design of the arcade cabinet had a very powerful monster drawn on it, and my boss said, This sound is a little too light.

4Gamer: So you did get some feedback during sound production?

Kamei: Well, I was making noise all the time. So coworkers passing by would say, "Whoa, what's that sound?" and then ask me about it and offer various opinions. There were also people like Ima-chan who had a lot of musical knowledge.

Imamura: Well, I didn't say anything about how it was to be changed. When "Space Invaders" was being developed, I was basically just drawing diagrams (laughs).

Kamei: No one knew about sound except us, so no one asked us like "Why do we need ±1% resistance?" For the invaders movement sound, Mr. Nishikado told me that he wanted something more dignified and heart-pounding, so I wondered if I could make it like the theme from the movie "Jaws" which was popular at the time.

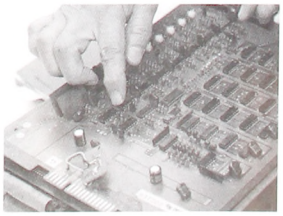
4Gamer: It's a well-known story that you've imagined the theme for "Jaws".

Kamei: There were always guitars around Mr. Nishikado's desk, and he played the guitar to give me an idea of the sound. I wanted to make it more powerful, but I didn't have enough skill or space on the board to build such a complex circuit. And then I dropped the pitches more and more, and the result was that sound. However, the moving sound is low, but I wanted to make a cute sound when a bullet hits the invader, so I made a sound like "Pecho!" (pasting/sticking sound). It was a slowed down version of the sound of the "Blue Shark" octopus when it appears.

4Gamer: I didn't notice that! I heard that the moving sound sometimes caused the speaker to break due to being lowered.

Kamei: I never imagined that could happen. So, at one point, I received a repair request along the lines of "there's no sound". So I went and replaced the board, but even then there was no sound. When I checked it out, the speaker cone paper had been torn. We were using cheap single cone speakers at the time, and they didn't produce that much bass. In "Space Invaders", we used filters to reduce the sound pressure, but even so, the sound was actually a sharp square wave, so they moved the cones around a lot. After that, all the maintenance personnel worked together to change all

"Space Invaders" was actually titled "Space Monster" until just before release. The bipedal monster on the side of the upright enclosure is a remnant of that.



the machines, even ones that had been shipped, from a single cone to a double cone with large grooves. It's only a speaker, but we couldn't leave something that was earning 600,000 yen a month without sound, so we worked on it quickly.

Work as a "production technology" not a "development"

Ishikawa: The upright cabinet of "Space Invaders" also acts as an enclosure, so the sound is much better than the TT cabinet (tabletop version). It makes the sound even more powerful. Was this effect all part of your design?

Kamei: No, I didn't think about it that far.

Imamura: We didn't have that feeling at the time. We weren't in "development" like Mr. Nishikado, but in "production technology".

Kamei: It was all we could do just to make the product. Once it was finished, we had to think about mass production. There were many kinds of boards for "Space Invaders", and sometimes we had to readjust them because the parts were changed. For example, we used Intel's TTLs at first, and then switched to Mitsubishi's second source products. The specifications were the same, but the characteristics are slightly different. The timing was changed, so we had to put capacitors here and there to fix it, but then the circuits were also changed, so we had to redraw the design.

Imamura: When the ROM was changed from 8K to 16K, some of the boards stopped working for some reason. I can't remember what caused it now, but we all got together and replaced all the ROMs.

Kamei: The program had to be rewritten at other times, and we replaced the ROM. I even went to the warehouse myself and disassembled and replaced parts on boards before they were distributed. Since my house was near the warehouse, I brought the master ROM home with me and erased and burned EPROMs at home.

Imamura: There was a lot going on then.

Kamei: We had a hard time with the power supply, too. In order to run the 8080 CPU and sound on that board, we needed a switching regulator that cost 50,000 to 100,000 yen at that time. But power supply for games had to be made for less than 10,000 yen, so we contacted various power supply manufacturers, but they all said, "That's impossible".

4Gamer: The power consumption for processing is far different from what it is now.

Kamei: TDK was the only company who agreed to do it. These inexpensive switching regulators for games were the first in the industry, and if we hadn't had them, we wouldn't have been able to mass-produce "Space Invaders" the way we did.

Imamura: Speaking of mass production, it was around this time that Taito purchased the building for the Ebina Plant. It just happened to be the timing when the production of "Space Invaders" couldn't keep up with manufacturing, so we were glad that we bought it. But actually, I found it even more helpful than that. During the development of "Space Invaders", a regulation was brought in stating "You can't make video games unless you have your own factory".*

4Gamer: So it became impossible to outsource manufacturing anymore.

Imamura: So, if we hadn't had the Ebina Plant, we would have been in trouble. We took turns going to the Ebina plant and building arcade machines with part-time employees, while also doing our usual work (laughs). The plant was still a barracks back then, though.

Kamei: The first time I went there, it was dusty and empty, so we first cleaned it up and built a production line. There was a growing demand for table cabinets, so we were making more and more of them. We also made a machine that lifts and moves a tempered glass plate with a suction cup. As a side note, I even made a counter machine for production line management. I thought it would be more efficient if we could immediately see how many units were made on each line, so I made something that displayed large numbers. But the part-time workers said, "This is too much pressure for us, so remove it!" After all the hard work I'd put in making it (laughs).

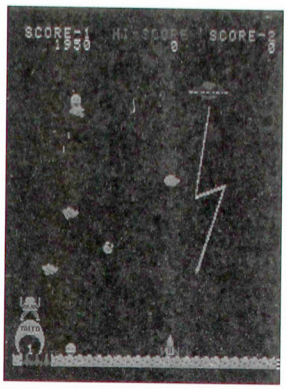
*Electrical Appliance and Material Control Law, Supplemental Provisions (Act No. 305 of November 11, 1977)

'Space Invaders' recognized as music

4Gamer: By the way, do you remember the "Disco Space Invaders" record? The recording studio was located next to the head office of TAITO, and TAITO cooperated for the sound recording.
Kamei: Oh, I remember that. I remember being told about it after the record was made.
Imamura: I have this at home, but we (the development staff) were not involved in it. wonder if the sales department handled it?
Ishikawa: It must have been. We didn't have a development department in Tokyo.
4Gamer: Starting with this, a variety of related records were made during the invader craze. YMO also adopted the sound of "Space Invaders"[3], and led to a situation in which people started humming the invader sound.
Kamei: I was simply happy to see it. But at the time, I didn't even tell my friends that I made the sound. A friend of mine who didn't know anything about my job said to me, "If you work for a game company, why don't you make games and sounds like Space Invaders?" (laughs). I didn't say anything for about 10 years, so I don't think there were many people who knew about it even within the company. It was Mr. Nishikado who was credited as the author, so I felt that I shouldn't do that, so I kept quiet.
Imamura: Internally and externally, sound was still the second or third most important thing. This was a fact.
Kamei: After ZUNTATA, when people who were really good at making music joined us, the atmosphere changed, and then we became aware of having copyrights and the like.
4Gamer: Until then, it was very normal to not be given recognition.

Exploring the post 'Space Invaders' sound

Kamei: By the time "Space Invaders" went out of fashion, we were trying to make many new games using the same board (by changing ROMs), but since the sound was fixed, we had to make a new audio board every time. However, it would be very hard if we had to attach the parts directly each time, so we made the sound circuit into a cartridge. Do you remember that?
Imamura: Oh, yeah (laughs). The one that allows you to insert about eight on a bake board.
Kamei: We used one cartridge for each sound, such as an explosion or a car exhaust. I made sure that what could be re-used was re-used, and then we made one or two new sounds for it. I've done a few of them in this way, and gradually I'd come to think that it would be better to use the CPU to make the sound programmable. No one told me to do it, but I thought it was time. Using a Z80 CPU had become the mainstream of game development, and it was necessary to design a new board to meet the needs of that times. The PSG (AY-3-8910) was just coming onto the market when I was making "Space Cruiser" (developed along with "SPACE SEEKER", it became the first title on the TAITO SJ system board) so I decided to use it.
4Gamer: The SJ system had three PSGs, and it was quite a gorgeous sound source design for the time.
Imamura: It is actually four. There's one on the main board. But for some reason, it was only used as a port for the DIP switch and didn't make any sound. I wonder what we were trying to do there?
Kamei: I don't remember that. Anyway, if we use PSG normally, we can only play 3 tones at the same time, right? But in "Space Invaders", seven tones were being output at once. Without enough sounds, it wouldn't have enough impact. Of course, if you interrupt the program, you can play various sounds with a single PSG, but if the sound disappears during the game, the player's rhythm gets out of whack. It's also boring when you get hit by an enemy and there's no sound (due to lack of channel space). So, I thought that we wanted to output a lot of melodies and used 3 PSGs for "Space Cruiser". With nine notes, you can play a melody in the background.
4Gamer: It's a very different idea from the game sounds of later years, where they tried to devote as many channels to the BGM as possible. What was the



The board for "Space Cyclone" is based on the "Space Invaders" with improved processing power and an additional sprite display function.

[3] "Computer Game (Theme From The Invaders)" from the album "Yellow Magic Orchestra"

development environment like for PSG sound?

Kamei: I used the game board as a handmade personal computer. A mechanic designed it and put the keyboard with the switch exposed in a white handmade case. That was pretty fun (laughs).

4Gamer: So you made your own microcomputers in your company, right?

Kamei: I was able to control the sound board by observing that "when a command comes from the game CPU, the sound CPU makes a sound like this" and learning the program bit by bit. We were also experimenting on audio sampling (by using DAC) with that setup. It was 8-bit, so the sound I recorded didn't sound very good. It also had functions to display waveforms on the screen and adjust the pitch. Honestly, I didn't think this was much help because it was faster to listen to the sound directly. Once we have this kind of system, people with musical talent like Ima-chan would be able to play an active role, and that's when I moved on to other jobs.

Taito's Sound Development Department and Surprising Relationship with Taiwan

Ishikawa: I only have a vague understanding of how the sound development department was established at Taito, and I'm very curious about it. Although you have some knowledge of music, you've always been an engineer, right, Imamura-san? How did you come to be in charge of the sound development department?

Imamura: Well, in order to understand it, we have to talk about Taiwan first.

4Gamer & ZUNTATA: Taiwan!?

Kamei: We were also shipping "Space Invaders" overseas.

Imamura: Taiwan was a bit special, at the time. Importing Japanese products was prohibited, so they had to have a local factory. So, we also went to Taiwan (for technical guidance).

Kamei: Ima-chan went first, and then I did. I remember that as soon as I arrived there, a local engineer brought a "Space Invaders" board and said, "Mr. Kamei, please repair this. The invader's eyes are not displayed", so I checked and found that one of the data output was short-circuited. After I repaired it, he said, "Actually, I showed this to you as a test, because I wanted to know how skilled you are, Mr. Kamei". Mr. Imamura had told us "it can't be fixed" and left it.

Imamura: I don't remember that (laughs).

Kamei: Thanks to that, people there recognized me as an amazing engineer, and I had a lot of advantages (laughs). I knew I was going to see Ima-chan for the first time in a long time today, and I suddenly remembered that story.

Imamura: I think that was the only time Kame-chan went to Taiwan, but I went there the following three years in a row. For four months in the first year, for three months in the second year, and for two months in the third year... In the second year, I went to Taichung to set up a game corner for Taito in a department store, and the year after that, the following year was also busy and I had to fly back and forth. Meanwhile, Kame-chan was developing a hardware that uses three 8910 (PSG), which I had absolutely no idea about. But when I came back, Kame-chan said something like, "I used three PSGs, so I'm sure you'll be okay now. Do your best!" (laughs).

Kamei: As I mentioned earlier, I thought that only a person with a good musical sense could use this, so I didn't feel like doing it by myself. Also, at this time, I had other jobs coming up. I was using a different CPU, which is M68705, to prevent pirated copies of the board.

"Lunar Rescue" & "Balloon Bomber"

Imamura: As I moved back and forth between Taiwan and Japan, I came to work not only in production technology, but also in design, which is a little more like development. At that time, I hadn't been told about using the 8910 for sound. However, Nishikado-san and myself were the only people who could read and write stave notation (sheet music), so I was contacted by colleagues who asked me, "I would like to have music for games, but how can we do it?". In short, it is an analog sound circuit, not much different from an invader board, and we can write a program to change the frequency of the port

and make it play a single tone melody.

4Gamer: There was finally a movement to put proper background music on the game, not only the footsteps of the Invaders.

Imamura: When I came back to Japan from Taiwan, I borrowed Mr. Nishikado's guitar and played a little bit, and wrote down the tunes in the score. It's a bit of an on-the-side job, but that's how the coffee break music for "Lunar Rescue" (released in November 1979) was created at first.

4Gamer: Do you have any scores left that you wrote at the time?

Imamura: No, no (laughs). I wrote them, handed them over, and then the job was done. Also, the next one "Balloon Bomber" (March 1980) was the same. I wrote the score for that and handed it over to the development team and that was it. I don't even know what happened after that (laughs).

Ishikawa: Wow. Was "Balloon Bomber" Mr. Imamura's work?

4Gamer: "Balloon Bomber" is the first game ever to have constant BGM. In that sense, it's a historical work, but there are some boards on the market without BGM. I wonder if BGM came to be attached halfway through.

Imamura: No, it was attached from the beginning.

4Gamer: That BGM sounds a lot like the nursery rhyme "Goodbye"[4].

Imamura: I don't know about that at all. I took the image of swinging balloons and made it sound like that.

Tsuchiya: So that's how you came up with game music back then! I'm just amazed at the creativity, It's so moving.

The "Fifth Laboratory" was born.

Ishikawa: How did sound development become its own department from there?

Imamura: I've written about that before in the article "ZUNTATA and I" for the 25th anniversary of ZUNTATA. When I came back from Taiwan and settled down for the first time in three years, my boss asked me if I wanted to start a sound division. It all started there.

4Gamer: So, in 1981 to 1982, sound development started as "Fifth Laboratory".

Imamura: There were three members at first, I was in charge of management and music, the other two members were in charge of systems, sound effects and electrical circuits. I think the person in charge of sound effects and electrical circuits was still a rookie at that time. After them, two new members who later created songs for "Wyvern F-0" and "Bubble Bobble" joined the company at the same time. Ogura (Hisayoshi Ogura. He created the DARIUS series, etc.) was mid-career recruitment, but the time when they joined the company was almost the same.

Tsuchiya: By this time, had you already start interviewing and hiring people?

Imamura: Yes. The first three of us were working for about a year and a half. Then the topic of growing the department came up. The music I did during that period was "Alpine Ski" (released December 1981), "WILD WESTERN" (released April 1982), "Jungle Hunt" (released July 1982), and "TIME TUNNEL" (released October 1982). Many of these compostions are still preserved in books of sheet music from the time (Looking at the score that he brought with him). This is the one from "TIME TUNNEL" and this is the one from "Chack'n Pop" (released in April 1984).

4Gamer & ZUNTATA: That's priceless!!

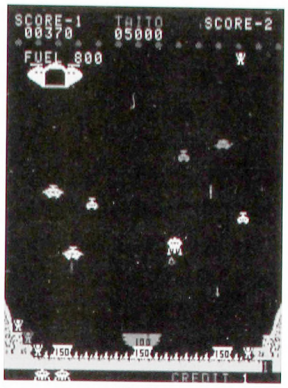
4Gamer: Some of them even have a chord score.

Imamura: It's not all the same. For example, "Chack'n Pop" is just a kind of memo. There are some compositions that I wrote just to pass the time.

Tsuchiya: All the titles you've worked on have impressive melodies. That these phrases come to mind just by looking at the screen shows the high level of your compositional ability, and I don't think it's usually possible to do it this way. "Elevator Action" (released June 1983) is awesome. The gang comes out and they're shooting their guns, but the song is so cheerful...

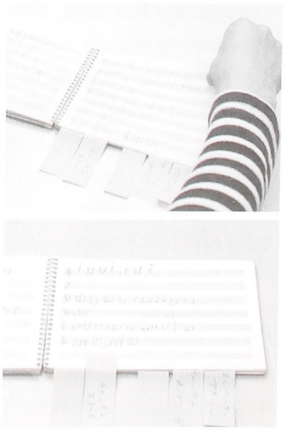
Imamura: Even if the game content is like that, the characters and their movements are comical, aren't they? When I first saw the screen, the images I had in my mind were "Western", "gangster", "a little jazzy" and "fun".

4Gamer: Did you take your cues from



Lunar Rescue (1980)

[4] Published in 1934. Composition: Kouyou Kawamura, lyrics: Yoshimi Sato.



existing gangster movie music, for example?

Imamura: There was nothing like that. I've had a long career as an instrumental player myself, so I've listened to a lot of different music, but I don't really think about any particular piece of music when I'm composing. I just made it as I felt it.

Tsuchiya: Is it something that just leaps into your mind?

Imamura: No, I played Nishikado's guitar and when the direction of the song was established, I would write down it on the score... no, actually I didn't write most of them down (laughs). I liked "Jungle Hunt" the best, but there's no score left, that means I probably wrote it just like a memo. By the way, don't forget about "Birdie King" (released in June 1982) from this time. Do you know that the composer of the theme song was Shin Yasuda... from Crazy Cats?

4Gamer & ZUNTATA: Wow!

Ishikawa: What was the story behind that?

Imamura: I think it was related to sales. One time, I heard "Mr. Yasuda likes golf and is interested in the sound of golf games", and he came to our sound room in the company. He asked me, "How about this music?" and gave me a music score. I did that on PSG.

Kamei: He came in very casually.

4Gamer: Everyone thought that the first use of a famous composer for game music was around 1985[5], so this turns the history of game music on its head, doesn't it?

What is Mr. Imamura's musical background?

4Gamer: By the way, did you have any specialized music education?

Imamura: No, I did not at all. My sister was a Beatles fan, so I became aware of music and started playing the guitar when I entered junior high school. In those days, group-sounds (Japanese rock) and folk music were so famous, and I was more into folk music. As soon as I entered high school, I started playing the saxophone in a brass band, which was more like classical band, and my senior students invited me to play with the Yokosuka Symphony Orchestra. But the saxophone doesn't come up very often, so I started playing percussion... That's the way I've been doing music. I still play the percussion in an orchestra, though.

Tsuchiya: I see! Imamura-san, you've had some experience with chordal, melodic, and rhythmic instruments, so you've been able to make music as a whole. That's a very important factor. I don't think you would have been able to make such music if you had experience with only one instrument.

Imamura: You make it sound so good, but I didn't think anything of it at all (laughs). In my mind, I was just a player, not a composer. Because I've never had any experience with composing. Because I could read music scores, I was placed in that situation, and I just did what needed to be done. Nothing more.

Kamei: Even from my point of view, Ima-chan is certainly great, but at the time it was quite normal and he just had to do that, because he was the only one who could. I don't think he was feeling any pressure to do something amazing.

Imamura: Our boss just told us to do something, so we did it. There were no specifications or specific instructions on what to do.

4Gamer: So, it was up to each person to decide. I think that's the main difference with modern game sound production. Recently, it's normal to have a sound department in game companies, but how was the position of making sound at a company at the time?

Imamura: Some people treated us badly at first. One of my bosses told me very clearly "We don't need music for games". I didn't think he should be saying that inside the development department.

Kamei: But we were able to do what we wanted to do, right?

Imamura: Well, on the other hand, there were some people who were willing to work with the music. For the ending theme of "Chack'n Pop", the programmer said he wanted a happy song for it, so I arranged the song "The Marriage March", and he added some movement of characters matching the music.

[5] For example, SEGA ENTERPRISES (at the time) tied up with Yoko Ishino's song of the same name "Teddy Boy Blues" (Arcade, released in May 1985). Enix (at the time) employed Koichi Sugiyama for the song "Wingman 2" (PC-8801 / PC-9801 / X1 / FM-7 / MSX, released in April 1986). In addition, Kunihiko Kase (formerly a member of The Wild Ones) announced in the October 1985 in the "LOGiN" magazine that he was going to produce music for NES (the specific work is unknown).

How MSM5232 was adopted

4Gamer: Just when the SJ system was about to end, Oki Electric's sound chip (MSM5232) came into use. In games it started to be used in "Field Day" and "Victorious Nine" (both released in May 1984 in Japan), but how did you come to use it?

Imamura: First of all, the end of the 8910 was in sight. I'd used it with a lot of ingenuity, but there was a limit to what we could do with it. I've always had the feeling that I wanted something new. So, when Oki brought a sample, I decided to use it then and there. The sound quality is nothing compared to FM sound source, but it was had a little more capacity than the 8910, and since it can produce 8 tones at the same time, the price is acceptable when you think for a comparable result would require several 8910's. So no one opposed this idea. If I hadn't wanted to make it more musical, the 8910 would have been enough. But if you don't have a lot of tones, people get tired of it. There was a limit. I used to think that the musical element was the most important thing, and it was becoming more and more important actually.

4Gamer: At that time, there were people like Mr. Ogura who joined the company as "musicians", so it was even more important, wasn't it?

Imamura: Yes, that's right. The first job I gave to one of them was to write a conversion program that would auto-replace the music data made on the 8910 for Oki's chip. The music for games like "Field Day" and "Victorious Nine" would have been made with the 8910 before, and it was very complicated to rewrite them by hand, so I had them make a conversion program.

Ishikawa: Now you mention it, there are two versions of the sound for "The Legend of Kage" (released in October 1985 in Japan), one is on an Oki chip and the other is FM. Did you use a conversion program for that too?

Imamura: No, that was written separately... I think.

The twists and turns of the FM sound source

4Gamer: Oki's chips weren't used for very long, and soon the era of FM sound sources came.

Imamura: I was one of the first to pay attention to FM sound sources. When Yamaha's MSX personal computer (the CX5, released in 1983) came out, I wanted to use the eight-port FM sound chip (YM2151) in that computer right away, so I went to Yamaha directly to negotiate with them. With the guy from the Taito agency. The director of Yamaha gave me a pretty good answer, and I thought I might be able to do it, but Yamaha's sales people said no. No matter how major Taito was, the number of games that can be handled by arcades and home systems is so different that the sales staff didn't want anything to do with it. Then the man from agency got angry before I did, and it was a lot of trouble every way. (laughs)

4Gamer: Certainly, console hardware easily surpasses the shipping number of arcade games, as production numbers exceed a million.

Imamura: Well, while this was going on, at the same time Yamaha was also making an upwardly compatible chip (YM2149, SSG) of the 8910. The temperature characteristics were much better when compared to usual products, so Taito introduced this one. When the YM2149 was used more and more, I don't think Yamaha could ignore Taito anymore. They started to make YM2203 (SSG chip with 3 FM voices. Popular name: "OPN") and then they brought it to us and said, "Please use it". To be honest, I thought, "WHY, YOU..." (laughs). But no matter how it came about, I wanted to get it to make sound better as soon as possible, so I used it right away.

4Gamer: Taito's first game using the YM2203 was "CYCLE MAHBOU" (released in December 1984), which was the first game in Japan to use the FM sound source.

Imamura and Kamei: Hmm, I don't know that one.

4Gamer: There's a theory that it was brought in from an external developer.

Imamura: Well, Taito didn't develop it,

that's for sure. Our sales people have different companies to make products, and they'd just come to us, and suddenly tell us "We'll make this kind of board". So, we didn't know the details.

4Gamer: Which makes the first FM sound source developed in-house is title "The Legend of Kage"? How about the YM2610 (popular name: "OPNB"), which became the next major sound source after YM2203?

Imamura: I remember the 2610 very well, and even though I was able to play six notes with the 2203, I was becoming more and more motivated, and I started to feel that it was still too little. So, we put together our specification requests in a list, and brought it to Yamaha. By that time, Taito had already used quite a lot of 2203s, so Yamaha was quite willing to listen.

Ishikawa: Did Yamaha and Taito develop this product together?

Imamura: It wasn't much of a joint development, but it was more a case of whether Yamaha would be interested in making it. Taito didn't fund development, it was more, "If you can make something like this, we'll buy it".

4Gamer: That's why in later years it's used by more than just Taito.

Ishikawa: There is a story that the 2610 was originally designed to output 6 channels of FM sound source, but due to poor yield, it was reduced to 4 channels. After a long time, then the YM2610B was released and it was able to put out 6 channels properly.

Imamura: You've done your homework (laughs). That's right. We did indeed make a request for 6 channels. But when I was told that there are only 4 channels, I thought "Well, I can't do anything about it" and I had to split them 2:2 or 3:1 for music and sound effects. But other parts were as we requested, and SED had been established by that time. I decided to leave the rest to the musicians.

Taito Sound's secret weapon "SED".

4Gamer: What is the "SED" that you just mentioned?

Ishikawa: That was a sound editor made by Taito, which was used until the early 1990s. At the time, it was said to be the best in the arcade game industry. No other editor was not so easy to type music in. It was a truly revolutionary tool that allowed us to write music data in a form that was closer to a musical score than previously, where we had to input it in hexadecimal numbers or something like that. It was a bit like Music Macro Language (MML) in some ways.

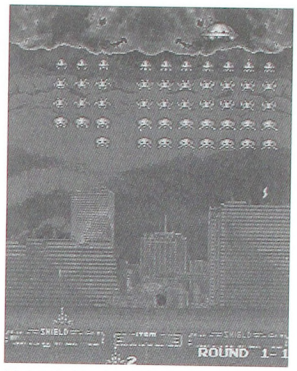
Imamura: The existence of SED is an indispensable part of the story of TAITO's early sound development. It's crucial to remember that it was vital for the creating quality sound. When the sound department was started with three people, the first thing I did was to have the person in charge in "Fifth Laboratory" make the SED. He'd also suggested creating a more musical sound editor himself. We already had MIDI at the time, but we didn't have the know-how to convert data from it yet, and I thought it would be too much work to do it by ourselves. So, creating SED was one of the sound team's goals when we started.

4Gamer: What was the sound developing environment like before that?

Imamura: There was a game development environment built by the people who developed "Blue Shark", which we mainly used. This is a partly modified version of the game's development equipment with sound editor functionality. I'm sure they were still using it until around "Elevator Action". We had to arrange the note information vertically (just like writing program data), and if you were a technician like us, it wouldn't be too hard to use it. I knew that if music experts who had no technical knowledge came in sooner or later, it would be too much for them to handle. So, I had them make something that we could input the notes horizontally, just like the music score. In fact, I think that Ogura and other colleagues had a lot of trouble because of it. When they joined the company, the system wasn't yet fully established.

4Gamer: How did they store the data?

Imamura: In the beginning, it was on magnetic tapes. As long as we used that development environment, it was also the only option we had. This was another thing I thought we needed to change with SED. As a result, the new development



Majestic Twelve (1990)

environment became a very simple one. It was the golden age of the PC-9801, and all you needed to do was plug the dedicated board into the 9801's slot to use it. You didn't need any special processing speed, so it worked even on the cheapest model. That's how it became so relied upon. In the previous development environment, the board was uncovered, so there were frequent contact failures (laughs).

4Gamer: When did you start to use SED?

Imamura: Hmm, when was it? Since it's a debugger, I don't know which title specifically.... At the least I think it was already in use during "Darius".

4Gamer: Listening to you talk about it, it sounds like the SED's interface is a horizontal version of the tracker[6] from later years, or it was something that predates the idea of what is now known as the piano roll. Pitch information is written in such as A, B, C, D.... But its duration (note length) is determined by the length of the horizontal axis. And that length was visualized.

Ishikawa: That's exactly right. we can manage it on a track-by-track basis. I'm one of the last generations to have used SED, but since it was there since I joined Taito, I came to think of it as being commonplace for game development. I was surprised to learn later that it wasn't at all. I heard that other companies had been using a vertical input environment for a long time, so I thought it was a breakthrough.

Imamura: It was a very flexible environment. It was absolutely vital to us.

4Gamer: By the way, what kind of work did you use SED for, Mr. Ishikawa?

Ishikawa: For about 2 machines, so not many. I used it for a Mimo (Taito's internal name for medal games) and for some of the sound effects in "Metal Black" (released in November 1991).

Not-so-everyday tasks

Imamura: As the development of SED progressed, new members came in, and the new sound chip became available... and then another new job came in. It was to develop a robot that played a musical instrument.

Ishikawa: Is it the guitar-playing robot Gen-Yu (released in 1989)?

Imamura: That, too, but there was one before that (According to the company's history, it was called "Ensemble de Robot", developed in 1984). This could only be done by people who had expertise in musical instruments. I was the only member of the sound department at the time who was familiar with a lot of the instruments, so I was in charge to doing it. We asked the head of development to get an acquaintance of his to come and had that person handle the music, but I played the recorder for the demo (laughs). That's how I ended up focusing on the robots, and while I did direct the sound of the game, I basically left it up to everyone else.

4Gamer: So that's how the division of labor was established.

Imamura: Ogura and others joined the company and since they got accustomed to the SED, I could leave the music part to them. The only thing I've always been strict about was "The sound has to be alive, even if it's typed in". Since I've been exposed to live music on a regular basis, I thought it would be meaningless if we didn't do it properly. That's why whether it's PSG or something else, I feel I have to do my best. Going back to the story about "Gen-Yu", Takami Asano, of GODIEGO, made the first 50 songs. That was pretty hard work, too. Once or twice a week after work, I went to the equipment room at his house. He arranged 50 carefully selected songs, making the best use of Gen-Yu's ability, and had them converted into MIDI data.

4Gamer: Mr. Asano also composed game music for "Chase H.Q." (September 1988) and other games at the same time, didn't he?

Imamura: I think we got to know each other while developing the LD game "Space Battleship Yamato" (released in July 1985) or something like that. I was introduced to him at that time.

4Gamer: How did you get involved with the sound for the LD game?

Imamura: In the case of LD games, Toei has professional composers and sound effect engineers, so we basically left it to them. I would tell them whether it was good or bad, and if they needed help, I

[6] A tool for arranging sound data represented by letters and numbers, representing time in the vertical direction. Conceptually, it is similar to SED.

would give them advice. However, "Time Gal" (released in 1985) was a little different. At that time, I played with Ogura and the others in the composer's private studio, which was actually a room in a typical apartment building.

4Gamer: Why were you in that situation?

Imamura: I originally intended to judge the finished product. I took them there because I thought it would be good for them to have a variety of experiences. But when we arrived, the composer said that it was not yet finished. Something went wrong in the process of making it. In the end, since they needed a lot of help, we had to stay up all night to help them.

4Gamer: So you shouldn't have had to do anything at all, but you ended up helping out by accident? (laughs). By the way, since the album "Taito Game Music" (LP record / cassette tape, released in 1987), Taito's game music has been recorded one after another. How involved were you in the production of the records and CDs?

Imamura: I left the communication with labels such as Scitron to Ogura. I mostly just made a yes / no decision. I've been doing music myself for a long time, so I could feel that their was a need for game music records and CDs, and I know from my experience how much time and effort it takes to do it, so I generally never said "No". However, when we talked about things that might cost a lot of money, I negotiated behind the scenes. The one thing I remember well is the concert. Everyone wanted to do it, and I wanted to let them do it. So then I thought it was my job to get the president to say "Yes", so I put a lot of effort into it.

The qualities a Taito sound creator needs

Tsuchiya: Around that time, more and more people wanted to make game sound. What did you focus on when interviewing candidates? I feel like the people of Taito's sound department were very unique (laughs).

Imamura: Yes, it was important to make sure he or she was 'unique' (laughs). However, Ogura was brought in by a salesperson or someone because he wanted to join. At that time, I knew that we would be short of people in the future, so it made for a relatively easy decision (without considering whether he is 'unique').

Kamei: Actually, a person who was not sharp in some way, he or she wouldn't have been hired for Taito's development.

Imamura: Yamada (Yasuko, ZUNTATA nickname Yasko), Furukawa (Norihiro, AKA Nakayamaraiden) and Umino (Kazuko, AKA Karu) were also such persons. In this generation, a lot of people who graduated from music colleges joined us. From my point of view I was wondering, "Why do you want to do game music even though you've studied music?" I thought that alone qualified them as 'unique'.

4Gamer: It's very common nowadays that people who have graduated from a music college want to make game music, so it seems like a long time ago.

Imamura: But even after we hired them, there were people who weren't suited to making game music, and many of those people left by themselves.

The Mysteries Behind the Sounds of Taito's Console Games

4Gamer: So, you've mainly talked about sound development for arcade games, but what about the early home video games? We have very little information about the people who worked on these games and how they worked.

Imamura: Well, there was no one in charge.

4Gamer: Really!?

Imamura: From my understanding, the sales department was in charge of console games. We don't know what was going on there at all.

Kamei: In the beginning (mid-1980s), console games were produced by subcontractors, or cooperative companies. At that time, Nintendo was in charge of all manufacturing, and we were limited to manufacture up to five game titles per year. However, eventually the NES market greatly expanded, and we were permitted to manufacture home console games inhouse as well. Then we talked

As a side note, the original copy of the "Time Gal" laser disc that Mr. Imamura kept was given to TAITO for the purpose of this interview.

about which department would manufacture, and it came to me, who was in the production department at the time.

4Gamer: Did you have an in-house production system in the company?

Kamei: The production team for console games was separated from the hardware team. But we thought it was strange that the development department and production department were separated, so we created a new department that integrated the two divisions, and I was recruited into it. At first, it was a very small department, but then a development team was formed there, and we started developing our own products for consoles. Revivals of past works were also needed, so Mr. Nishikado became the head of the development section. But I'm not sure how we handled sound...

Imamura: I remember being asked for the score.

Ishikawa: The score for porting certainly remains an internal document. I just don't see any indication that they actually made it.

Imamura: We didn't make it in-house.

Kamei: We probably only handed over the music scores and then the subcontractors did the rest. I didn't know the details of the sound source because I was a production engineer at the time, but I remember looking at the ROM board and thinking, "This is only the size of a tape recorder's". I realized as long as you had the original data, you could reproduce it in other environments.

Tsuchiya: Kamei-san, you were in the console games division after that, weren't you?

Kamei: That's right, in the PlayStation days too... That's when I made a controller for "Densha de Go!".

Ishikawa: Mr. Imamura went to the console team later too. Shortly after I joined the company, you were transferred from sound division to console, and became the head of that department.

Imamura: Yes, I was selected for it. As a replacement for Mr. Nishikado.

Ishikawa: That's why our time in ZUNTATA has hardly any overlap. I do remember being scolded by you when you were the head of console development though: "What on earth is that sound!? (laughs)".

About Adoption of Ensoniq's Chips

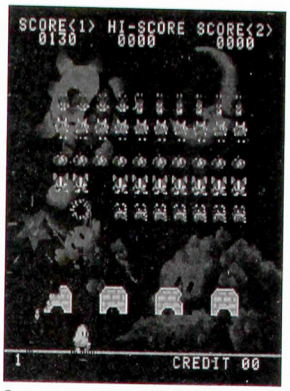
4Gamer: You were involved in the introduction of the Ensoniq PCM sound chip at that time, weren't you?

Imamura: The theme of Ensoniq came up around the time of the karaoke business. When I was asked "we've got this chip, what do you think about using it?" I was still in the sound depart. I don't remember if I said yes or not.

Ishikawa: When I joined the company, we were still trying to do karaoke on the Roland CM-64 or something. I was discussing with the person in charge of ZUNTATA at the time about whether there was something else we could do. I suggested that the Ensoniq would be a good idea, so I went to ask him about permission to use it and got a surprisingly good response. That's how it all started.

Imamura: That was in the relatively late period of my career. I've heard about this, but that's about as far as it goes.

We've rushed through the story from before the birth of "Space Invaders", the forming of the sound team, and then it being passed on to a new generation of people. It was clear that "Taito Sound has respected individuality from the beginning". There was no coercion, not much pressure to do things the way they should be done, and no tendency to keep up with the competition. They all worked out what to do from the given subject matter and environment, and they accomplished it using their own ideas. This attitude can be seen as the bud of the "ZUNTATA-ism" of later years. In that sense, "Space Invaders", "Darius", and the current ZUNTATA sound are all on the same line.



Space Invader DX (1995) with Ensoniq / ES5505 OTIS (F3 system board).

This a translation of an excerpt from an article published in 4Gamer.net on April 15th, 2020.

Interview with Space Invaders Invincible Collection's Developer "Gotch Technology"

Gotch Technology is the company responsible for porting the arcade version to create "Space Invaders Invincible Collection". We asked the person in charge of the game to comment on the development and their approach to porting it.

Gotch Technology

Gotch Technology is a Japanese game developer,founded in the 1990's. They specialise in developing high quality ports of arcade games. Some titles they have worked on:
Hang-on(in Shenmue), Scramble, Crazy Climber, Karatedo, Time Pilot, Moon Cresta (PS2), Namco Museum(PSP), Namco Museum Virtual Arcade (Xbox360), Namco Museum Remix (Wii), Capcom Arcade Cabinet (PS3 / Xbox360), Namco Museum (Switch), Arcade Archives series (PS4 / Switch).

— It's not only this project, but I think there are some parts that your company considers important in porting. Some parts are prioritized, and some parts are intentionally lowered in priority. It may change depending on the title, but could you tell us about your company's porting policy?

We believe that arcade games are a property that have cultural value and should be preserved for the future. In the past, we could play arcade games easily at the amusement centers (arcades) in town. But now it has become considerably more difficult.

— Unlike home video games, arcade games require special equipment such as boards and cabinets. If you don't have the expertise, it can be difficult even to just play. Also, unless they're playable, you're not really preserving video games. It is very important to keep arcade cabinets and boards, but ideally we would like to make sure that arcade games can be retained in a way that is recognizable as a "game".

That's why, whenever we're asked to port or revive an arcade title to the latest home video game consoles, we're keenly aware of the need to "preserve the original in a playable state" and "convey as accurately as possible the elements and playability of the original".

One thing we always keep in our mind is to try and maintain the format of a video game. The work of recreating the original is often completed within the scope of software technology, and can be accomplished without considering the product as a game. But we always want to remember that "we're making games".

— I think you analyzed the hardware (board) in parallel with the software, but what exactly did you do? Could

you tell us what you learned by analyzing the board and any developments at the time of design?

The porting process begins with the analysis of the actual board. This time, we had to start by reading the EPROMs because the hardware was from the 1970s. Early EPROMs require multiple voltage power supplies, so they cannot be handled by common equipment currently on the market. Also, some of the logic ICs used on the board are no longer in use, so it was necessary to examine the data sheets from that time.

In the past, one of the difficulties we experienced with porting development was that the data collection was not as easy as we thought it would be. Nowadays, we can find a lot of information on the Internet, so I really feel that it has become convenient.

If the software analysis reveals that the hardware needs to be investigated, we interpret the information from the schematic. If further verification becomes necessary, the required work is performed using the actual board and dedicated equipment. When handling actual boards, we will carry out the minimum necessary work while paying attention to the possibility of board damage due to the work.

I would like to talk about the parts that were impressive in each title in order.

SPACE CYCLONE

With "Space Cyclone", we got a feel for the historical progress of video game hardware.

The hardware used to display the objects has an interesting combination of elements of previous generations of "Space Invaders" boards and the next generation of sprite functions. This board is equipped with a star generator (hardware for displaying stars only), but instead of displaying stars randomly, it has a ROM for storing the star arrangement, and can arrange stars based on actual constellations. You can see Orion and the Big Dipper.

In the sound part, as an evolution from Space Invaders, programmable tone generation is now possible and a dedicated control CPU has been installed. This allows you to create a sound program without affecting the programming of the game.

For speech synthesis, CVSD (Continuously Variable Slope Delta modulation) sound sources are used, aimed at both sound quality and volume compression. CVSD is a technique that later evolved into ADPCM (Adaptive Differential Pulse-Code Modulation).

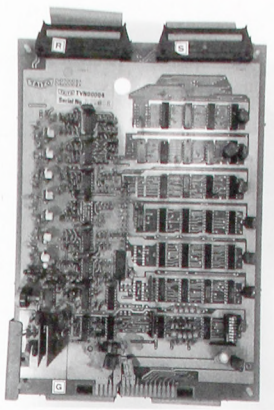
LUNAR RESCUE

"Lunar Rescue" is a modification of "Space Invaders" hardware. Due to restrictions on the scale of any modifications, it was impossible to fundamentally change the circuit, so you can see areas where they've given thought to reusing the existing circuit for the sound part. Changing the sound basically meant adjusting the parameters of the resistors and capacitors, so they're trying to create a sound that is as different as possible from that of "Space Invaders" while still using the same circuit. It also controls several tone circuits and outputs melodies. This was the circuit used to produce the movement sound of the invaders in "Space Invaders".

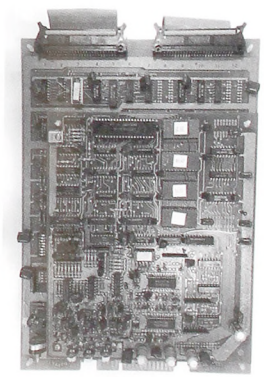
SPACE INVADERS DX

"Space Invaders DX" is a remake of the original "Space Invaders" using a board from the heyday of sprite display capabilities. This board has the sprite and background text features that were standard at the time, but these are not used in the game part of "Space Invaders". The sprite function is disabled and the frame buffer for it is released to the CPU.

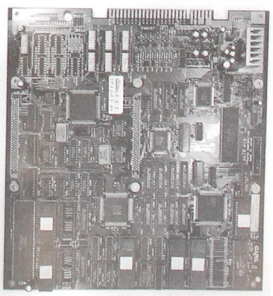
The CPU (68000) writes the display pattern directly into the frame buffer for sprites to display the game characters. This is exactly the same way that the CPU (8080A) writes the display pattern directly into the frame buffer to display the characters in the original (1979) "Space Invaders" board.



Space Invaders B/W version (1978)



Space Cyclone (1980)



Space Invaders DX (1994)

Interview Part 2

— The circuit diagrams for some of the boards were provided by Taito. And I also heard that a modification manual was provided for "Lunar Rescue". How did you use them?

As I mentioned earlier, when analyzing software, we first refer to the schematic to check the hardware behavior. Until the early 80's, it was often possible to understand all the behaviors by using schematics, so this was a very valuable resource for porting development.

For "Space Cyclone", we didn't have all of the schematics we needed, so we had to make the necessary parts of schematics from the actual machine while developing. In "Space Invaders", it was mainly useful for analysis of analog parts, such as sound.

Because "Lunar Rescue" was modified from the "Space Invaders" board, there was no complete schematic for "Lunar Rescue", so it was necessary to create the necessary parts of schematic by referring to the modification manual and the actual machine.

In the era of F2-SYSTEM and B-SYSTEM, custom LSIs were used for the boards, and the schematic contains plenty of information to decipher these functions and structures.

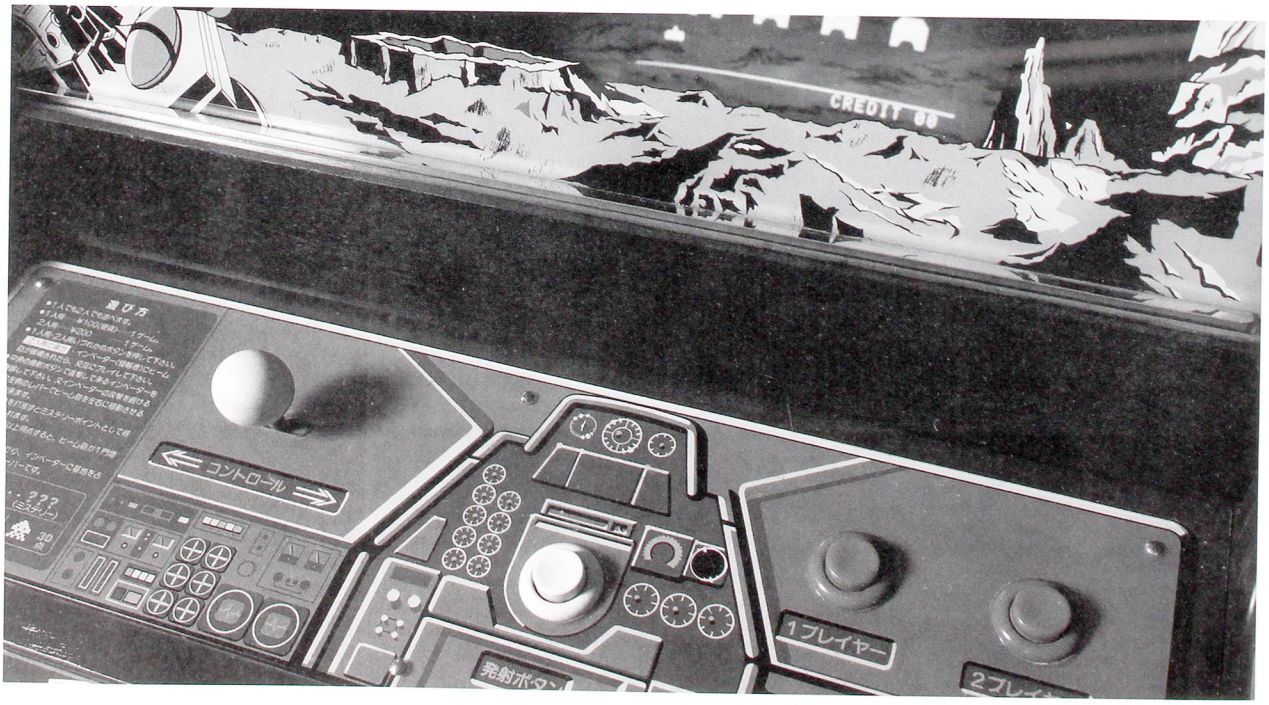
We are very grateful to Taito for providing us with these schematics so that we could use them effectively in our development work.

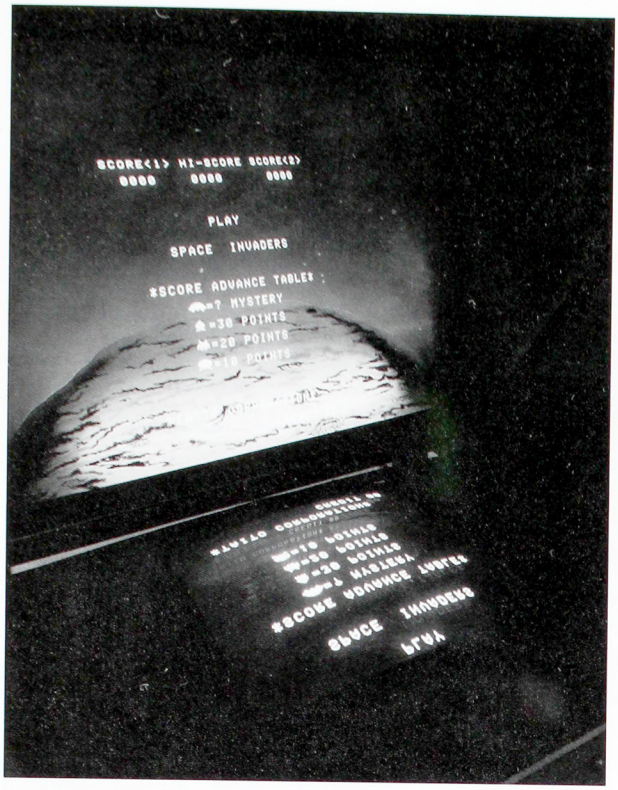
---- In those days, without a sound chip,methods such as turning the signal to the sound circuits on and off were used to create sound effects. When recreating these, were there any techniques you used or areas of difficulty?

We read the behavior of the operational amplifier circuit and the analog noise generator from the circuit diagram and the actual operating waveform, and programmed the game so it works in the same way.

In "Space Invaders", a technique was used to produce the sounds where they would sound different even though the sound source is the same, because the original and Part II used different software methods to control them. So we were careful to make sure that the sound is accurate even in such cases.

Packaged ICs such as CSG (Complex Sound Generator) produce relatively the same sound, but sound circuits made up of a combination of analog components vary greatly in sound due to variations in the parameters of individual parts or deterioration over time. We had to keep in mind what the original sound was like and put them together as one product. So,





this is not the same as porting the sound of a game assembled with digital circuitry.

— I think you had to analyze and modify the software in order to add the challenge modes. Could you tell us about any difficulties and interesting points?

If you set "DUAL" to "TURN" in the game settings of "Majestic Twelve", you can play a different stage at the end of the game from previous Cattle Mutilation stages. It's hard to find just by playing normally, so we hope you enjoy finding it as well.

The basic parts of "Space Invaders Part II" are the same as the previous title. However, there are many new additions like new presentation and new enemy gimmicks, some of which are hidden elements that make the game even more interesting. It was fun to analyze those parts. For example, in Challenge Mode, the key is to achieve the rainbow bonus. But this bonus varies between 500, 800 and 1000 points, depending on the conditions. It's important to decide which invader to leave at the end.

"Space Invaders DX" appears very similar to the original "Space Invaders" on which it was based. However, we struggled in that the information we gained from analyzing the original game wasn't very useful because the internal program for things like stage control method had been re-written. We reproduced the specific glitch from the original "Space Invaders" where if you leave the rainbow for a couple of stages you're instantly invaded and the game is over, but if you look carefully, you can find that some parts such as the trajectory of the rainbows when invaded are different. It may be fun for the experienced players to compare the games with the originals and try and find these differences.

---- Do you have any other episodes from the porting process?

In the final phase of development of "Space Invaders", there was a glitch report that found "there's no noise present in the sound just before the Invader formation appears". Depending on the board you have, at this moment a very audible noise is heard. However, there was no noise on the board we trusted for reference which Taito lent to us.

Also based on the schematic, it was not possible to determine at what level the noise should be heard. We scrutinized a lot of information and finally decided to reproduce this noise. However, we were left with a keen realisation that a perfect reproduction of the behavior of circuits that handle analog signals was far from easy.

Staff Interview:

Making "SPACE INVADERS GIGAMAX" was a struggle against the weather!?

"SPACE INVADERS GIGAMAX" was a giant-format, vision-filling version of the game that could be played by up to twenty simultaneously. The 4SE version is included with this package; it was originally developed for ten players, which was further increased to twenty for the exhibition. Here we speak to staff members who were involved in developing GIGAMAX.

Yu Watanabe

Square-Enix Live Interactive Works. Creator and director of GIGAMAX. First encountered "Space Invaders" in elementary school when his mother won a PS2 at her company's sports day.

Shun Sekimoto

Taito
Game Development Team 4
Oversees all aspects of game design. His father collected game cabinets, allowing him to experience "Space Invaders" as a child.

Ikue Osugi

Taito
Game Development Team 3, Programming Division
Programmer. Only experienced "Space Invaders" for the first time after joining the company.

Nanoha Hata

Taito
Game Development Team 3, Visual Division
Designer. Oversaw projection mapping. Only knew of "Space Invaders" from hearing her father talk of playing it at a local coffee shop. After joining Taito, she oversaw "Arkanoid vs Space Invaders".

Shinsuke Hosaka

Taito
Game Development Team 3, Programming Division
Programmer. Played "Space Invaders" on the Famicom as a child. Also played the arcade version at resorts on vacation with family.

Shohei Tsuchiya

Taito
Game Development Team 1, Sound Division
Sound designer. Never experienced "Space Invaders" before joining the company, but worked with the original's sound director Michiyuki Kamei (p. 34) after joining the company.

Developing GIGAMAX

— How did the GIGAMAX project start?

Watanabe: The first step was being invited to a meeting with the Tokyo City View, Roppongi Hills Observation Deck staff. They asked if it might be possible to project something, perhaps "Space Invaders", on the windows of the observation deck. About ten different ideas were discussed, and the one that resonated most was GIGAMAX. Everyone thought it sounded fun, and that's where it started.

— So they came to you.

W: That's right. It was a tight schedule. Afterwards, we realized it was the 40th anniversary from Wikipedia, and rather than a one-off thing we thought it would be better to do an anniversary event, and other people got involved, and that's how "PLAY! The Space Invaders Exhibition*" happened.

— How long was the development period?

W: We started before summer, and the prototype was ready by autumn.

Sekimoto: Once the specs were decided there was only two months to release. All we had was a prototype, and nobody had decided how to spice it up yet. That's when I was rushed on board, and so I locked down all the specs on the first day and had them implement.

*The PLAY! Space Invaders Expo was a 40th Anniversary Space Invaders event held at the Roppongi Hills City Sky View observation deck from January 12-31, 2018. https://tcv.roppongihills.com/jp/exhibitions/play_space_invaders/

The Aim of GIGAMAX

— Tell us about your goals for the GIGAMAX design. Did it start from multiplayer, or was it about the size of the screen?

W: Multiplayer was first. The original name for GIGAMAX was "Super" Space Invaders. Something that would go beyond the original, was the concept.

— How many players did you envision?

W: At first, ten.

— Isn't it surprising nothing like that had been done before?

W: Definitely. There wasn't any multiplayer "Space Invaders" to that point.

Sekimoto: Right. The three main points were ten-player simultaneous, then the fact it'd be projected on the Roppongi Hills Observation Deck windows, then that it would be the axis for a bigger event. We knew pretty much anyone anywhere in the world knew the basic gameplay. And we figured that by playing against the night sky, seeing how well you could do with the other players, would be exciting and memorable.

— The final product certainly delivered on the concept.

W: The concept was "fighting together", where you'd cooperate to defend the skies over Roppongi.

S: The cooperative aspect came off well, I think. Cooperative is hard. The sense of everyone being in it together really came together on the boss stage, I think.

Careful positioning was key to the endeavor

— GIGAMAX used projection mapping, which must have introduced all sorts of issues with the shape of the event space. Tell us about Roppongi Hills.

Osugi: The Roppongi Hills observation deck windows have frames, so the projection had to accommodate those.

Hata: We used a special tool designed for projection mapping called "MadMapper". But it was our first time using it, and the first time we'd been to the location too, so it was really difficult. The only way to adjust the projection in realtime was by physically positioning the projector on scaffolding.

— You must have done this after business hours.

H: Yes. If we didn't properly set up the scaffolding for the projector the position would be off, and the projection and angle would totally change. And we couldn't get a sense of how multiple projectors would overlap without seeing them in action on site.

W: We did it all in just two days!

H: Yeah, it was winter, and we were up on the 52nd floor of the Roppongi Hills Mori Tower, the top floor, and it was freezing...

W: The must've turned off the heat after it closed for the day.

H: We only had from 10pm until morning, so basically until sunrise at 5am or so.

— How many people were pulling all-nighters on those two days?

W: All the development team here went, but there was a limit to how many could work at a time.

S: We on the dev team, then someone sitting and watching to check and debug, so four?

O: Debugging was a mess too.

S: The image would come into focus or disappear depending on where you sat, or be blocked by a pillar.

— That was part of debugging too?

S: You had to have someone sit in each position, make sure it could be seen, and there was no lag. We needed a lot of people for that. We had a debugging company send staff that worked through till morning.

— Sounds like planning for a concert! Did it finally go off smoothly?

W: We were able to do the event without issues.

H: Thanks to all the coffee everyone bought me!

Setting up at Huis Ten Bosch and Laguna Ten Bosch

— Then you took it to Huis Ten Bosch in Nagasaki. Was it basically just moved as-is?

O: We had to rebuild parts of it. When

the player count went from 10 to 20, the screen needed to get wider so we worked on that.

W: For the Roppongi Hills setup, one PC was sufficient, but at Huis Ten Bosch we needed two machines, in a server-client arrangement.

— I heard that because you couldn't get twenty controllers running in Unity, you had to go with the server arrangement.

W: That was part of the, but we also had to deal with the distance between where the machine was and where the players were actually playing, so that informed the decision to go with the server-client system.

O: There were length issues with using USB cable, so we were forced to go with Ethernet cable instead.

— Was it easy to get it running on multiple machines?

O: It kind of felt like starting over, we had to redo the input portion.

— Were there any behind the scenes dramas at Huis Ten Bosch like there were at Roppongi Hills?

W: It was about the same.

S: We were scouting around, trying to find the right place for it in the park. It was February. February, middle of the night, and it's on the waterside.

— Must have been cold!

S: It was freezing. Even wearing a down jacket for hiking, I was chilled to the bone. We worked until like 3 or 4 in the morning in this situation extreme enough to make you come down with a fever.

— It's really windy down there, and it must have been pitch black.

S: It was, it really was. And there was a lot more work that needed to be done in comparison to Roppongi Hills. The screen ratio needed checking too. On our side we had to make all kinds of fixes. The appearance of the models, the colors used to differentiate 20 players at once, all sorts of trial and error. But simply getting it projected for the first time was extremely challenging.

— Had you tested the projector itself?

S: Yes, partially.

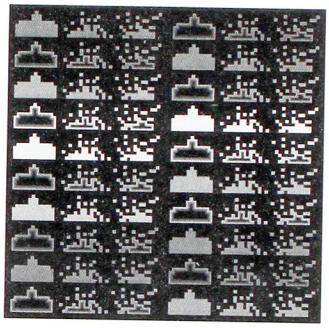
O: It was at the level of having seen how big of a projection we could get. The projector for Roppongi Hills was too small. So we had to experiment how to get double that.

— As the screen size and ratio change, so does the balance of the characters.

W: And as the player number jumps from 10 to 20, you need to think about how wide the screen needs to become.

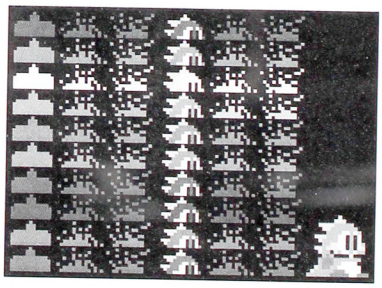
S: The Huis Ten Bosch version is really wide, so we implemented a ribbon of light on the player's ship so they wouldn't lose track. We needed that.

H: The color balance was something we worked on too. The glass surface of the Roppongi Hills observation deck was translucent so we had to really use strong colors, but at Huis Ten Bosch we projected on a wall, so it was sharper, and we needed to rebalance the colors. We also needed to differentiate 20 different colors.



O: We projected all sorts of images to test how the colors would look.

H: Bubble Bobble characters, Space Invaders cannon variations, things like that.



O: I remember that! Yeah, we did.

H: We did a preview in the afternoon. That was the best.

Everyone: Laughs

H: The team finally got a chance to spend the afternoon playing around in the park.

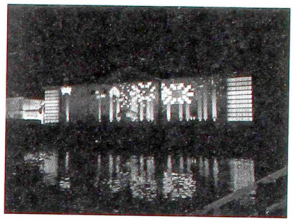
— Sounds fun!

H: We figured since we'd pulled off Roppongi Hills that Huis Ten Bosch would be a piece of cake. We were wrong! It was really hard.

— How long did it take to develop the Huis Ten Bosch version?

W: Not too long.

— How many times did you go to Huis



Ten Bosch?

O: It was like I lived there (laughs).

W: In the end stretch we were there a week, up to that point I think we took two two-day trips.

— The setup at Laguna Ten Bosch, in Aichi prefecture, had a different feel. Was it hard to do, too?

S: So at Laguna Ten Bosch, the issues were positional. Such as how cables couldn't span the river. At Huis Ten Bosch the projector and PC could be on the same side, but at Laguna Ten Bosch the projector was on one side of the river and the players on the opposite side. We had to come up with ways to communicate across that gap.

O: There was a lot of distance involved in the setup, with the PC being across the river, and the work itself was largely done on that side, with a remote desktop setup.

GIGAMAX Sound

— Tell us about producing the sounds for GIGAMAX.

Tsuchiya: There are numerous versions of "Space Invaders GIGAMAX", each with their own sounds. Generally what happened was we'd go to the event space to get a feel for it, then make the sounds and hand off the data. I really caused a lot of headaches for Osugi and Hosaka (laughs). One thing I paid close attention to was the sound of the shots, because when the sound of the shots of multiple players overlap it can get obnoxious. So I spent every day searching along this razor thin line between a shot sound players could hear and feel, but not so much that it degenerated into noise.

— I played both Huis Ten Bosch and Roppongi Hills and didn't notice anything off about the sound, so I guess you really nailed the settings!

T: No, it was all thanks to everyone on the ground on site. When I got involved there was only about a month to prepare. Everything I wanted to do but couldn't with music and sound effects finally ended up going into this special edition. Each stage's music was designed to have a reasoning behind it. Initially there were three stages of three screens each, so I wanted a track for screen 1, 2, 3, like that. But in actuality it ended after 3 screens. I made 9 tracks and the ones that didn't get used finally made it into the "4 SE Version". I think only Osugi noticed what I was doing! (laughs)

— Nobody else noticed? (laughs)

T: Initially I started with an inorganic sound, then by the final song of the third stage progressed to entirely instruments. The story was the music becoming gradually more organic.

— Interesting.

T: The movement of the Invaders grew more organic as the game progressed, too. So in concert with that I increased the musicality of the score, so that the final track was pure instrumental performance, but players are only going to be able to experience that for the first time in SE. I wanted to make sure of that. I also included the Invaders "march" sound, that den-den-den sound, in every song.

— Did you implement the marching sound by ear, or did you sample it?

T: I did it by ear. The actual sound is a little too solid. It's amazing.

— Very powerful.

T: Exactly. So it overwhelms. It almost hurts. It was perfect for the position of the speakers in those old cocktail and upright arcade cabinets, but when it's flying straight at you it's a little hard to take.

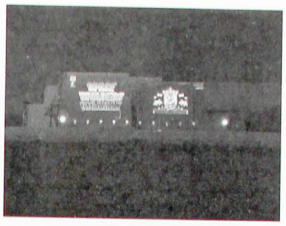
— So you processed and re-arranged it.

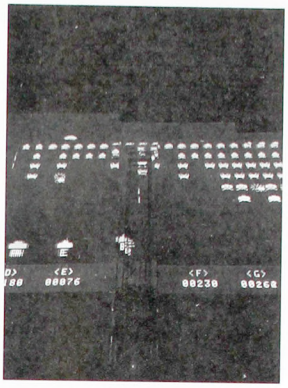
T: Yes, I basically re-did it.

GIGAMAX Goes Nationwide

— I heard you did a lot of traveling for this, Hosaka-san.

Hosaka: All over the place. Abeno Harukas in Osaka is a 60 story skyscraper, and we projected on its observatory windows just like Roppongi Hills. That was two setups of ten players each.

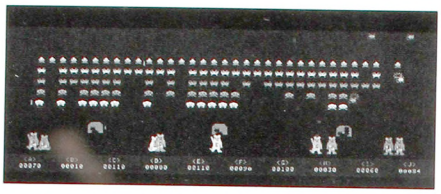




SPACE INVADERS GIGAMAX Locations (a selection)

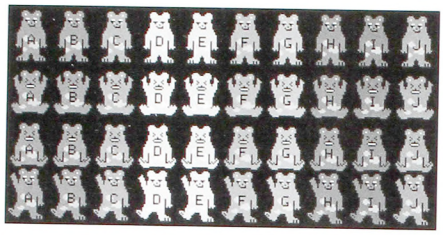
Date		Location	Name
2018/1/12	2018/1/31	Roppongi HillsTokyo City View	PLAY! Space Invaders Expo
2018/4/28	2020/3/31	Nagasaki Huis Ten Bosch	
2018/6/16	2020/9 - now	LAGUNA TEN BOSCH LAGUNASIA	
2018/7/21	2018/7/26	Omotesando Hills Space O	MEDICOM TOY EXHIBITION '18
2018/8/9	2019/1/27	Yodobashi Umeda Building	SPACE INVADERS ROOM
2019/6/7	2019/7/7	SKY CIRCUS Sunshine 60 Observation Deck	Mystery Expo in the Sky SUPPORTED BY Mu Magazine
2019/10/5	2019/11/2	Harukasu 300(Observation Deck)	Harukasu 300 Space Invader World
2020/6/3	2020/9- Now	EXBAR TOKYO	

Hata: The Abe no Harukasu version featured "Abears".



— Original characters?

H: Your ship became this bear character. It was a little weird using them like that, but I made the cute dot graphics and the directors OKed it (laughs).



All: (laughs)

O: There was another event, the MEDICOM TOY BE@RBRICK collaboration GIGAMAX, which was held at Omotesando Hills for the MEDICOM TOY EXHIBITION 2018.

H: We sometimes added new title screens, or stage-clear screens, or pixel art for various locations.

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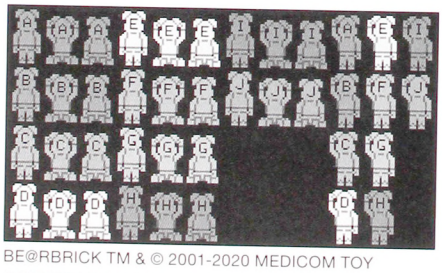

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For the Players

— Is there any message you'd like to leave for the players?

Watanabe: I'm just happy if everyone was able to get excited by the cooperative and competitive aspects. It's a party game.

Sekimoto: I wanted to make something where any player, regardless of experience level, could feel the excitement of competing for the highest ranking. And also, trying out new ways of fighting for a better score, like realizing how the level 2 Invaders explode when shot three times. I wanted to design the game length and experience so anyone could get to the end, just mashing the button and enjoying themselves, and walk away with a feeling of satisfaction and I think I achieved that.

Osugi: It's a little lonely playing alone, so try with your family!

Hata: I spent a lot of time on those dot-pixel graphics so please keep an eye out for them!

Hosaka: This is true for the entire "SPACE INVADERS INVINCIBLE COLLECTION", but the entire history of Space Invaders is really packed into GIGAMAX. The bug UFOs and Invaders from the very first game are all in there. So you can appreciate it as the progress of history.

Tsuchiya: Please search for my songs under the name ZUNTATA on Spotify and other streaming services!

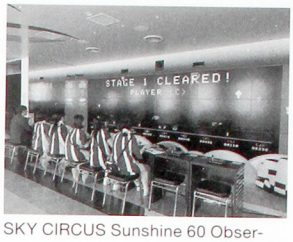
All: (laughs)

Sekimoto: The great thing about "Space Invaders" is that it can be enjoyed by all sorts of players regardless of age. I think of GIGAMAX as building on that core concept. This is a game you can enjoy yourself, of course, but you can give it to your kids, or your parents, and play together, party together, or take it to a special event so everyone can play together. So please try it in all sorts of occasions and situations!

— Any final thoughts?

H: I had two kids during the time GIGAMAX was being made!

— That makes them Invader children! Thanks for participating.



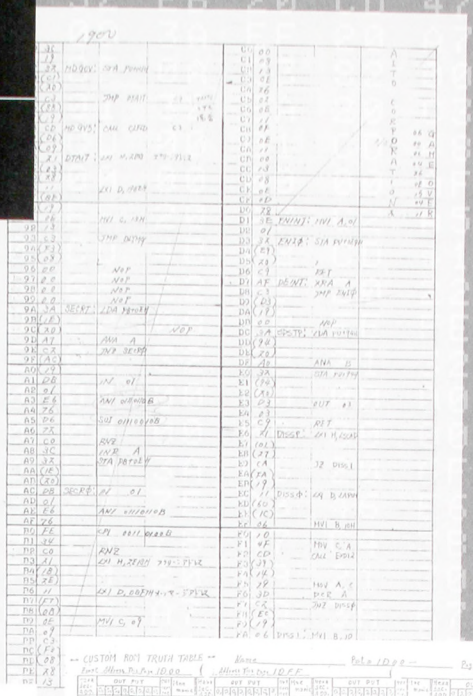
SKY CIRCUS Sunshine 60 Observation Deck

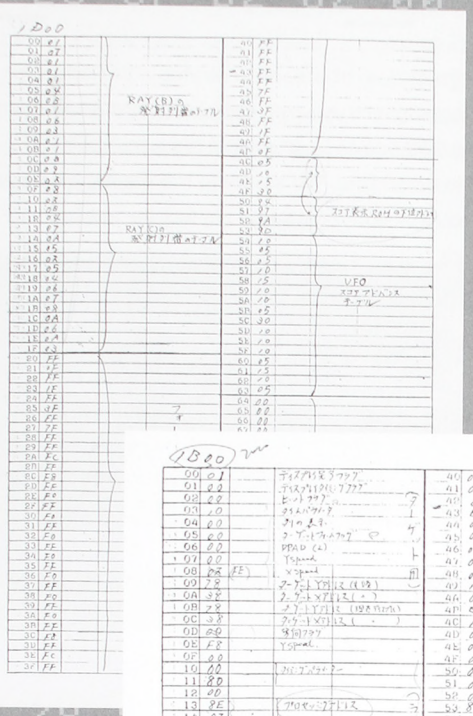
Harukas 300 (Observation Deck)

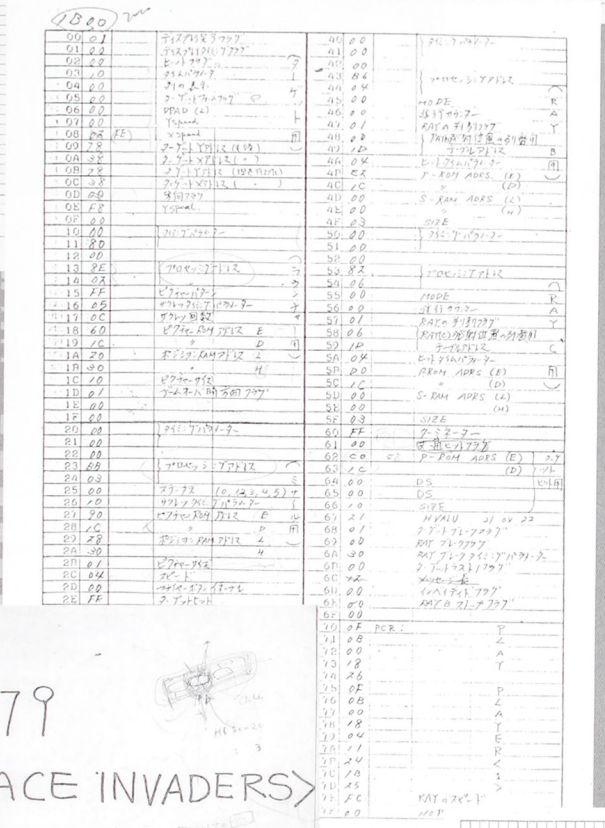
EXBAR TOKYO

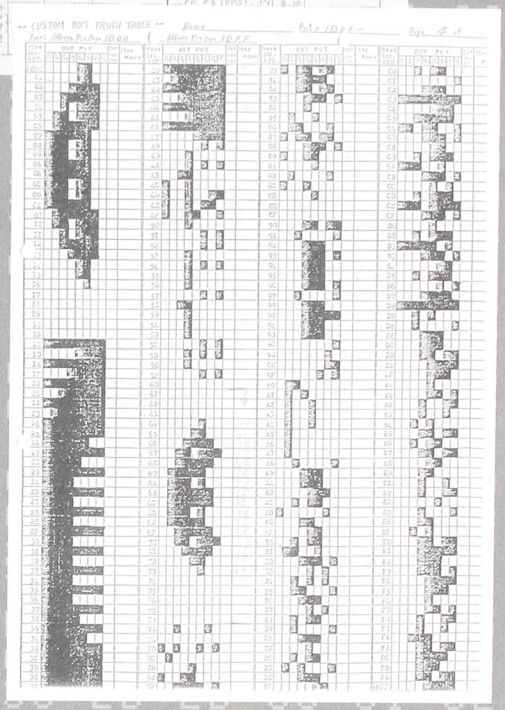
CHAPTER 3
SPACE INVADERS DESIGN DOCS

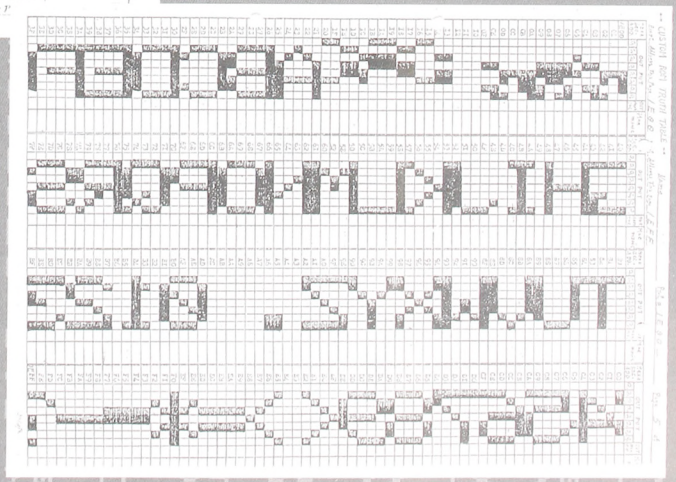
3 DESIGN DOCS











Space Invaders STRATEGY

fukkokuya, winner of the Space Invaders Championship, is a master of the game. Here he reveals trivia and techniques for making it to the top!

fukkokuya

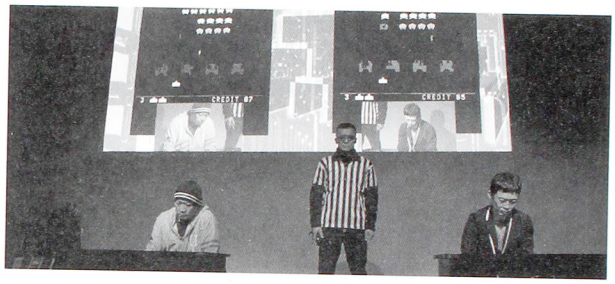
Profile

Real name: Atsushi Ishida. Born 3/20/1968. First became obsessed in elementary school. Purchased his own cabinet ten years ago.

The 2/14/2016 Space Invaders Championship

The Space Invaders Championship was held on February 14, 2016, as part of the digital game expo "Play! Game Expo Stage 1: Digital Games All Night" program at Skip City in Kawaguchi, Saitama. It was a collaboration between Saitama prefecture and Taito. Amazingly, this was the first "Space Invaders" competition officially recognized by the company.

The competition centered on the eight players who made it through the semifinals. In the semifinals, players were given three minutes, and in the finals, five minutes, to attain the highest possible score. The short timeframe required a great deal of precision strategy. In a battle on the high stage, fukkokuya was the player who shot down all UFOs for 300 points to attain the top score of 6990 points in the timeframe. We spoke to the champion for his thoughts on Space Invaders and his tips for playing.



Invader Techniques from the Champ

Q What's the best way to play the first screen?

From the left, wipe out columns two, three and one in that order, then waste shots up to shot 22, so you can use the next to take out the 300 point UFO that enters from the right. After blowing up the UFO, waste 14 shots and wait for the second 300 point UFO to appear. Then waste another 14 and hit the third UFO. If you shoot the Invaders during this time they will really speed up, so that's why you want to waste shots until you kill the third UFO. Once you do that, begin clearing out the lowest row, until you've fired 14 shots. Shoot the next 300 point UFO, then take out the two leftmost columns and the lowermost row without wasting any shots. That should be 14 shots, at which point you should wait and take out the next UFO. After that you can fire at will.

If you want to get another 300 point UFO, leave two columns of four (for a total of 8) Invaders and wait for the next UFO. If there's any less than 8 a UFO won't appear.

Q What about the second screen?

Basically the same as for the first screen; prioritize taking out the three columns from the left. Until you get used to it, it can be hard to move while under fire from the Invaders, so first focus on shooting out columns one by one.

Q Are there patterns you can use to beat the game?

I definitely have my own set style of shooting. If you can play using the same spots and same timing every time, you could call that a pattern to attack the game. But it isn't possible to trace out a single pattern, so you can recover even if you lose your way.

Q What's your advice for novices?

The Invaders descend one row after each traverse of the screen, so the best move is to take out the columns on the edges. The next trick is managing your shots so you don't miss. Shooting the Invaders' shots waste time, because the next shot will start descending even before you hit the first. There are 55 Invaders on a screen, for a total of 990 points. The difficulty ramps up as you move to subsequent screens, so the best way to rack up high scores is to patiently target all the UFOs on a given screen rather than rushing to the next screen.

Q How does the scoring of UFOs work?

It varies based on the number of shots you fire. As you can see from the chart, they turn 300 points every 8th shot, but shooting 7 shots and waiting isn't time effective, so my style is shooting 8 plus another 14 for a total of 22 shots, then hitting a UFO with the 23rd.

Shot	Points	Shot	Points	Shot	Points
1	50	9	100	17	50
2	50	10	100	18	100
3	100	11	100	19	150
4	150	12	50	20	100
5	100	13	150	21	100
6	100	14	100	22	50
7	50	15	100	23	300
8	300	16	50	Back to 9th	

Q How do you count your shots?

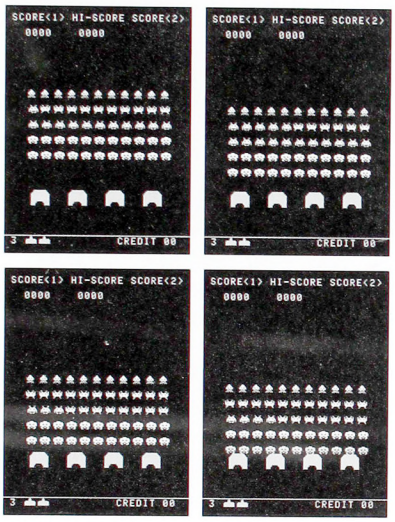
One at a time (laughs).

Q Do the UFOs move in a pattern?

It depends on your shot number, and the screen. On the first screen, if you're aiming for 300-pointers, they come from the right, left, left, right, left, left, left, left, left, right, left, right, left. My record for a single screen is 13 UFOs, for a total of 4890 points.

Q From the second screen the Invaders start lower; is your pattern the same?

On the second screen the Invaders start three rows lower. Because of that it's harder to move, so the safest bet is clearing the columns from the left inward. The third screen starts two rows lower than that; screens 4-6 a row beneath that; and 7-9 start one beneath that.



Q Is there any pattern to how the Invaders move?

In 1P mode, the invaders move left to right; in 2P mode, they move the opposite. In that case you need to watch out when doing the Nagoya attack because the final Invader is moving the opposite of normal. Specifically on screens 4-6 you'll use the shooting method for 7-9 and on 7-9 you'll use the method for 4-6.

Q Any other techniques you can teach us?

There's one called the 'self-destructing UFO'. You shoot the UFO right at the edge of the screen as it's about to disappear. It disappears as if you'd missed, but the collision seems to get carried over, so when the next UFO appears, it instantly explodes.

Q How do you determine the version of Space Invaders that you're playing?

With ROMs,

TV Version: 4-digit score
SV Version: 4-digit score
Late SV Version: 5-digit score
CV Version: 5-digit score

But the SV and CV versions each have a variety of ROM numbers, so as a player simply looking at the screen, the difference is pretty much the number of digits in the score; gameplay is the same.

Q Are there any differences in the motherboards?

The upright cabinets have L-shaped boards; the cocktail cabiners have three board variations. The L-shaped boards were either manufactured by Taito or MIDWAY, and while some are labeled Taito they were actually made by MIDWAY. The three boards in the cocktail version are the B&W version, the color-compatible B&W version, and the color version. The B&W version is, as the name implies, designed for black and white; it would need to be physically modified to output color. The color-compatible B&W version is designed with a socket so that a color output component could be added as needed. Both types show evidence of the graphics-related parts having been modified. I describe the different versions by the names of the parts they use:

Early: 25S10 version
Mid: 74LS151 version
Late: MB14241 version

Q What is the strategy for "Space Invaders Part 2"?

The difficulty really ramps up as the screens progress. It's like the designers were issuing a direct challenge to players.

The first and second screens are pretty much the same as the first game, to the point where a player who couldn't reliably clear the third screen on the first game won't notice any difference. But 500 point UFOs and a "rainbow bonus" have been added, raising the potential top score on the first screens.

On the third screen, the UFOs drop 30 point Invaders.

Screen 4 is where Part 2 gets interesting. The Invaders begin to split, the spacing of the rows makes it hard to do the Nagoya attack, and the UFOs keep dropping more Invaders – it's enough to make you panic (laughs).

My personal strategy for Part 2 is not waiting for UFOs or doing the Nagoya attack. At first glance Part 2 is a much harder game. But the splitting enemies that prevent the rainbow bonus, the placement of the rows, and the weird spacing feels like a love letter from the designers to those who mastered the first game. On the other hand it came out after the boom had cooled, and it unfortunately didn't get much distribution because of its difficulty and similarity to the original. Which makes now the perfect time to give it a shot!

Q Any specific tips for Part 2?

1) If you can clear the first screen in 55 shots (not wasting even one), you'll get a bonus life. Same for the second screen. Starting on screen 3, the UFOs start dropping Invaders, so you won't be able to clear the screen in 55 shots. Theoretically it's possible if you keep the very top row intact so the UFO can't drop an Invader, but it's extremely hard. From screen 4, the Invaders start splitting so it's totally impossible.

2) If the bottom left 10 point Invader "rainbows", the rainbow bonus is raised from 500 to 1000 points.

3) The start positions on each screen are the same as the original. After clearing screen 9 the placement reverts to that of screen 2.

Space Invaders SOURCECODE

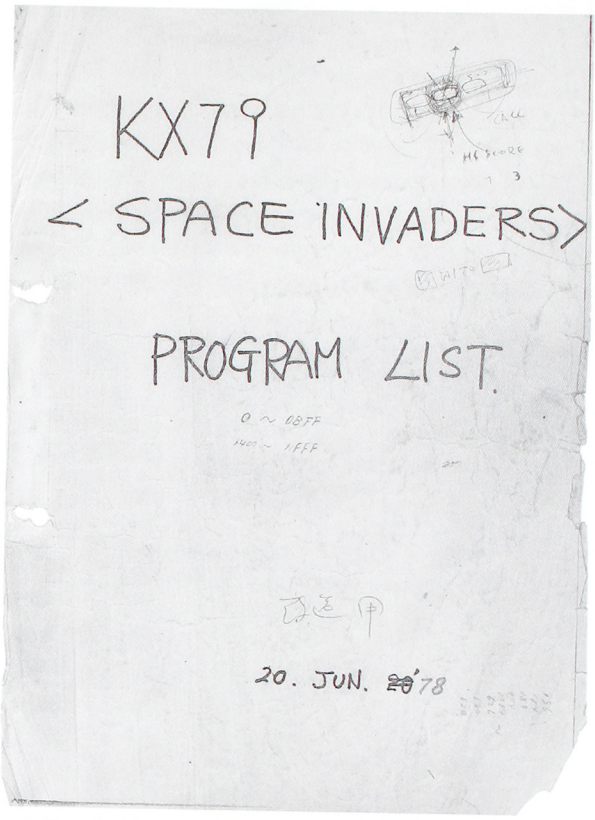
Space Invaders creator Tomohiro Nishikado taught himself how to code. He held on to his handwritten programming sheets, and you can see a portion of them here.

The Space Invaders Program

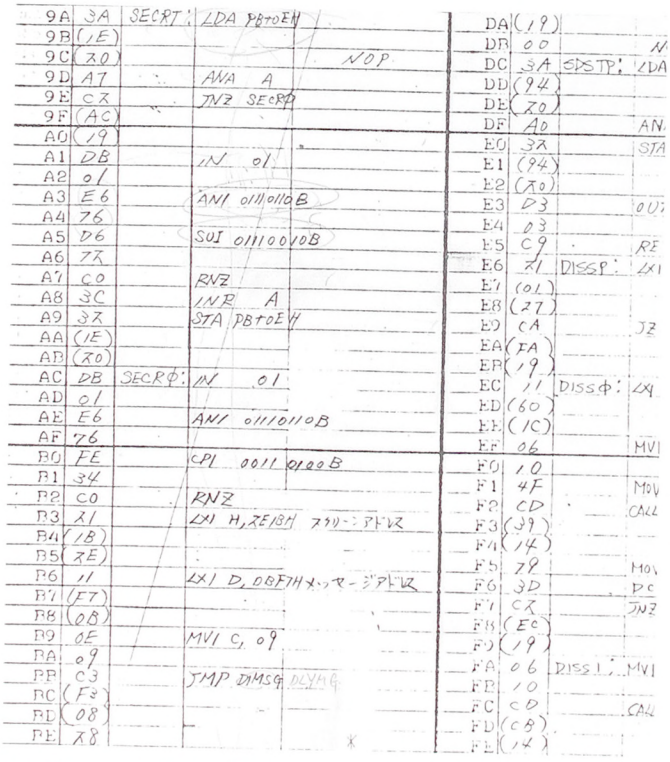
The following deals with programming language from more than forty years ago, so don't worry if you don't understand all the fine detail.

"Space Invaders" ran on an Intel 8080 chip. At the time, the only personal computers widely available were the Apple II and single-board machines like the NEC TK-80, and programs generally required "assembly" via the conversion of "mnemonics". But the Space Invaders code had to fit within 6 kilobytes (including the data area), meaning even the assembly had to be done by hand. This restrictive environment is undoubtedly what caused development to take more than a year.

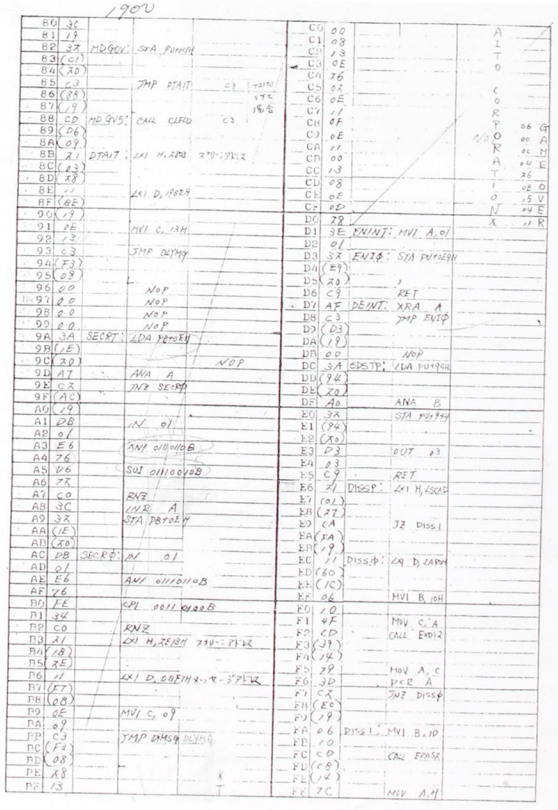
The source code snippets displayed on these pages were handwritten by Nishikado himself in assembling the program. There are 49 pages in total. The details can be tough to see in their reduced size here, so we've included blow-ups of key areas. They're an amazing record of Nishikado's struggles.

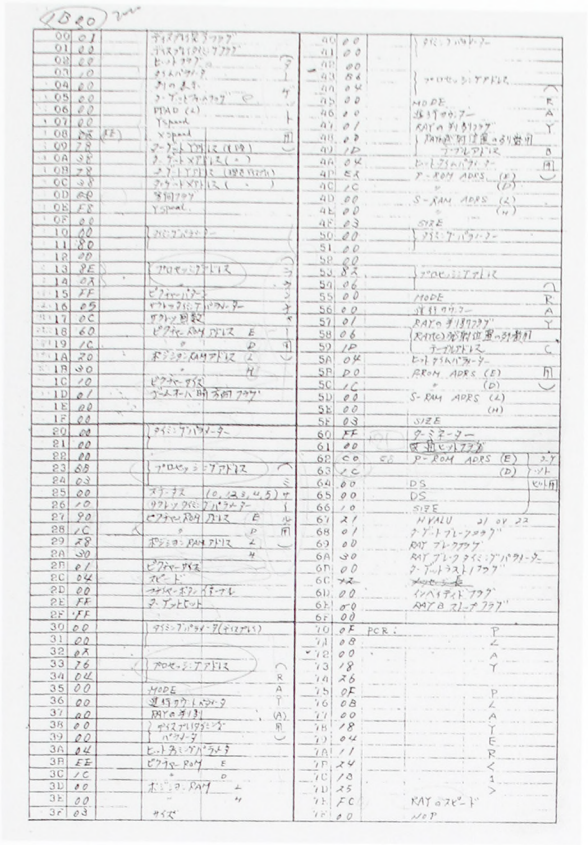


⬆ Let's start with the cover. Notes include "modification" in pencil and the date of June 20 1978 suggests this was revised after completion. You can also see the code ranges 0-0BFF and 1400-1FFF noted.

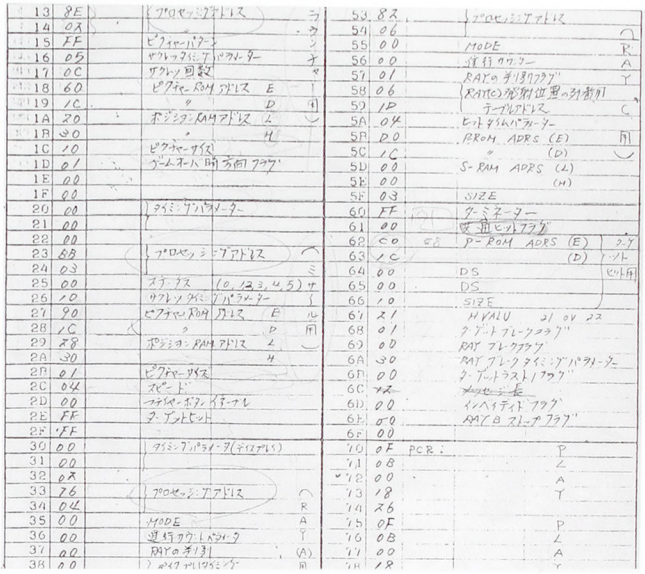


⬆➡ Code for 1980H -19FFH. The far left column is the address suffix, followed in order by machine language, label, mnemonic, and Japanese explanation. The SECRT: label refers to input from hidden commands. IN 01 reads the port, ANI01110110B filters by AND. Next CPI inputs. When the conditions are met, the message from 19BE is displayed. Can you figure out what the hidden command is?

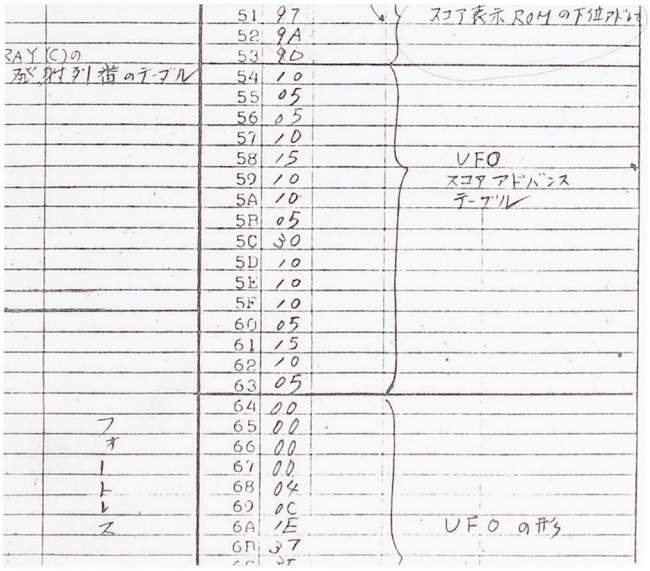


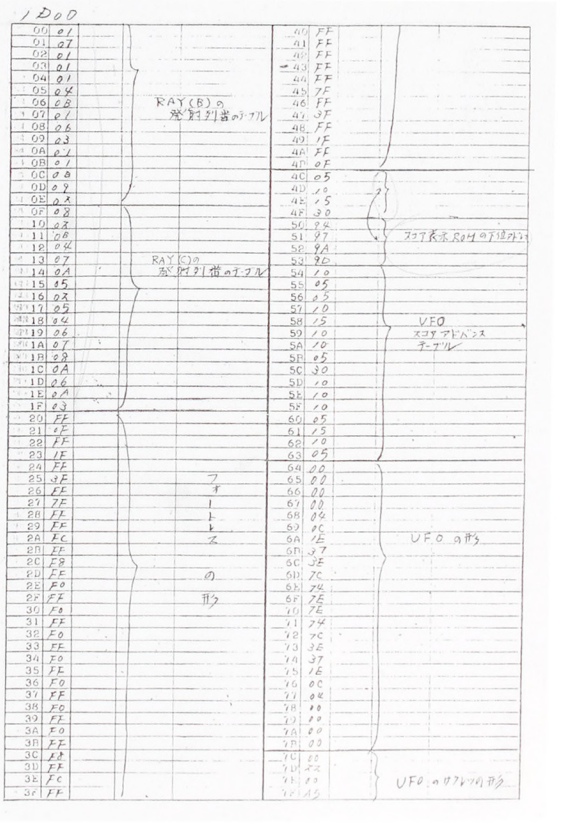


⬅⬇ 1B00H down writes the initial values for each parameter. During development, characters did not have names and were assigned titles such as Target, Launcher, Missile, and Ray. In the second half, 1B70H contains the "PLAY PLAYER <1>" text that appears upon game start. Unlike in PCs, which use ASCII, here text is defined in code (00 = A, 01 = B, etc.)



⬇➡ This is the second half of the ROM, same data storage area. Annotated "RAY (B) Firing Table", this defines the enemy firing sequence. Next is the note "Fortress shape" which is the bunker's graphic data. FF is filled with 16 dots, but since Space Invaders' screen is oriented vertically, the graphics are stored horizontally. You'd think "UFO Score Advance Table" would be the secret behind the varying UFO scores, but that actually starts from 1D55H (50 points), with 1D63H not being referenced and returning to 1D54H (100 points).





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